The FOUNDRY

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# Plan Interesting Features for Chicago Convention

OFFICERS and committees of the American Foundrymen's association now are formulating plans for the thirty-third annual convention and the twenty-second foundry machine and equipment exhibit to be held April 8 to 11, 1929, in the Hotel Stevens, Chicago. For the first time in a great

The Hotel Stevens, Chicago, the world's largest hotel, will be the scene of the next A. F. A. gathering

many years, the technical sessions and the exhibition of equipment will be held in the headquarters hotel. The recently completed Hotel Stevens, probably one of the finest hostelries in the United States, has 31,000 square feet of floor space available for exhibition purposes. While this space will not permit the individual exhibit to be as large as at Detroit or Philadelphia, it will be possible for each exhibit to feature important products. For that reason, more care likely will be exercised in the selection of the displays and in the main manufacturers will show the new developments which have taken place in their line of equipment recently and in some cases since the Philadelphia gathering. The success of the valuable meeting at the Edgewater Beach hotel, Chicago, in 1927, is an indication of the interest and enthusiasm which will be accorded the 1929 meeting in the midwestern metropolis, and with the added attraction of an excellent exhibition of equipment, the coming meeting should be outstanding.

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*Fig. 1—In the Old Foundry Bay the Molding Floors Extend from the Wall to the Center. Cores Are Blown Out by Immersing the Hot Castings in the Water Tank Shown in the Center*

# CLOSE CONTROL AND R

## *Feature Eastern B*

By Edwin Bre

MINERVA, daughter of Jupiter and patroness of all arts and trades, was credited by the Greeks with the introduction of the chariot. However, Virgil ascribes the introduction of this mode of transportation to Erichthonius, a mythical king of Athens, who is said to have appeared at the Panathenaic festival, founded by him, in a car drawn by four horses. It is unfortunate that the name of the real inventor of this mode of locomotion has been lost from the records of antiquity for he deserved his own particular niche in the hall of fame.

Previous to the invention of this remarkable vehicle, draft animals slowly dragged loads of material piled on rough platforms mounted on skids, similar to the stone-boats still used on many farms. Similar devices of much lighter construction were used as carriages by the wealthy people of that time. Even after the development of the chariot, it was some time before it was put to the lowly use of transporting all kinds of materials. At first it was used as a carriage in the triumphal marches of the returning victorious warriors through the city streets and the arena.

Chariot racing was one of the principal sports at the games held in the arena, and one has but to recall the stirring scene from *Ben Hur* to realize the thrill it gave the assembled populace. Later, it was discovered that the chariot with its plunging horses made a destructive engine of war, and with a few refinements such as attaching long, sharp knives to the hubs of the chariots, it was possible to cut down the opposing forces with still greater effect. At first, chariots were constructed of wood and leather. Later some genius conceived the idea of using bronze hubs

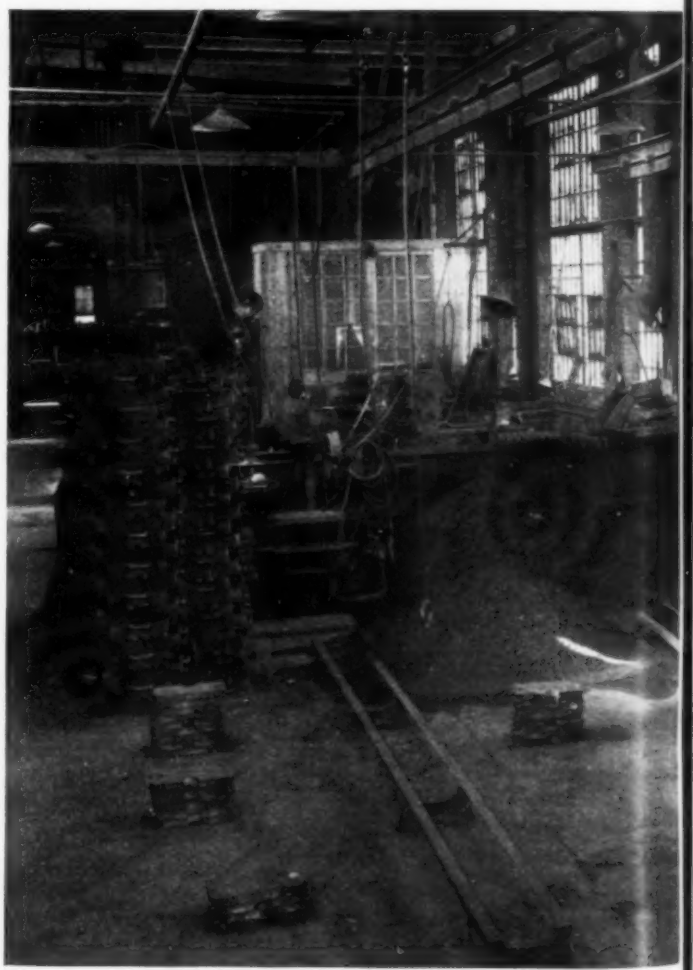


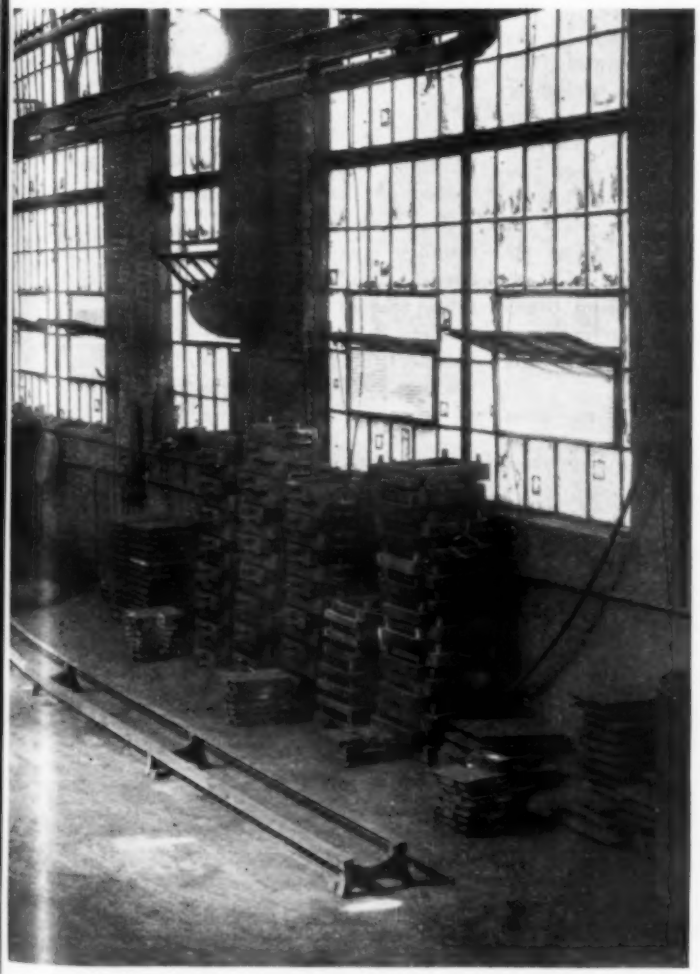
*Fig. 2—Large Windows in the Wall Give Ample Light in*

*Fig. 3—The Melting Department Is Located in the Center of the Old Foundry Bay. All Furnaces Are Oil-fired and the Metal Hoods Erected Above Carry Away the Smoke and Fumes*

# RECLAMATION SYSTEM

## *Bearing Foundry*

Bremer



*The New Foundry Bay. The Floors Are Parallel to the Wall*

on the wheels and beaten plates of bronze as a protective covering. When iron became available, thin strips of this metal were used for tires.

With the advent of the bronze hub and axle, it was noticed that the shrill screech from the friction between wooden axle and wheel was quieted, and that the axles and wheels lasted longer than formerly. This effect naturally was attributed to the bronze, and probably marks one of the first uses of bronze as an antifriction metal. However, with the increase of the chariot, and its later improvement, the cart with two or four wheels, it became a problem to supply a sufficient quantity of metal parts. Although bronze was a common metal, it was expensive, and the large amounts used in constructing wheels made the vehicles costly.

It was not long before some one more clever than his fellows evolved the plan of employing a thin, hollow cylinder or bushing of bronze which was placed inside the wooden hub. This development was a great step forward as it released untold quantities of metal for other purposes, and lowered the cost of vehicles to a point where they no longer were classed as luxuries, but were used widely in transportation of goods. Years later other metals were substituted for the bronze bushings, but the lesson learned from its use was not forgotten. When machinery first was developed, bronze was used as the antifriction metal.

Today, bronze still is used for bearings, but other materials, such as tin-base metals, termed babbitts, cast iron, mild, case-hardened and tempered steel and even wood, are employed. Babbitt metal probably is used more extensively than any other bearing metal because of its anti-

*Fig. 4—Cores Are Baked in Gas Fired Ovens under Pyrometric Control*

friction properties and its ease of handling due to its low melting point. Bronze follows babbitt and is found invaluable where heavy loads and high speeds are encountered. It answers the four requirements for a good bearing metal. A bearing metal should possess sufficient strength to prevent squeezing out of the bearing when subjected to a load; it should not heat rapidly and should have a high melting point; it should be able to resist abrasion but should not score the journal, and it should be uniform in texture and possess a low coefficient of friction.

Bearing bronzes are made in a variety of compositions and contain copper, tin, lead and sometimes phosphorus. Copper may vary from 70 to 80 per cent; tin from 5 to 10 per cent; lead from 9.50 to 25 per cent, and phosphorus from 0.25 to 0.80 per cent. Some bronze bearings have a shell back composed of bronze which is lined with a softer metal of the babbitt type. Some of the bearings are cast to shape, others are cast in the form of hollow rods or cylinders and others are cast as solid rods. In the production of the various types of bearings all operations of mixing, melting and castings must be carried out carefully to obtain a uniform metal and good castings free from defects.

One of the leading firms in the East, engaged in the production of bearing bronzes for machine tools, steel mills, steam engines, automobiles, as well as a wide range of other types of nonferrous castings is the Lumen Bearing Co., Buffalo, N. Y. This company make approximately 140 standard and special alloys including aluminum bronze, phosphor bronze and manganese bronze. The variety of castings produced easily may be gaged by the statement that the lowest number of different alloys used in the foundry in any one day was 23 and the greatest was 40. In addition to the production of bronze and brass castings, the firm also manufactures a number of white metal alloys for bearing purposes.

Three foundry bays with an area of 15,680 square feet are devoted to molding. Views of two of the bays are shown in Figs. 1 and 2. Molding sand is mixed in a muller-type, sand mixer made by the National Engineering Co., Chicago. A number of different types of molding machines are used. These include machines made by the Berkshire Mfg. Co., Cleveland; Osborn Mfg. Co., Cleveland; International Molding Machine Co., Chicago; Tabor Mfg. Co., Philadelphia; and the Johnston & Jennings Co., Cleveland. Fig. 1 is the original foundry as may be surmised by the type of windows employed. This bay, which is wider than the two newer foundry bays, also contains the melting equipment shown in Fig. 3. As may be seen in Fig. 1, the molding floors extend from the wall of the building toward the center. In the other bays the floors parallel the wall as may be seen in Fig. 2.

### Use Concrete Floors

All floors throughout the various departments, including the foundries, are concrete. The molds are placed on racks which raise them about 3 inches above the floor. These racks may be distinguished in the illustrations. They are built on cast-iron supports placed 4 feet apart. Angle irons fastened to the supports hold the molds. Also, the cast-iron supports are higher on one end than the other which allows the molds to be poured uphill or downhill, according to whether the gate end of the mold is placed on the low or high side.

The numerous alloys used in the foundry are melted in oil-fired furnaces of the crucible and non-crucible type, and in an electric furnace. The Lumen Bearing Co. has 8 open-flame furnaces made by the Monarch Engineering & Mfg. Co., Baltimore. Four of these have a capacity of 1000

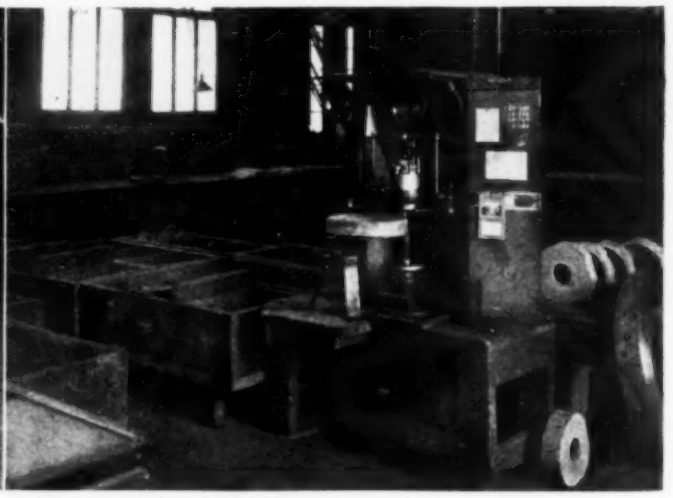


*Fig. 5—Sprues and Gates Are Removed by Band Saws. Fig. 6—All Castings Are Inspected for Defects. A Brinell Machine Is Used for Hardness Tests*

pounds each, two have a capacity of 2000 pounds each, and the other two have capacities of 500 pounds. In addition to these furnaces, the firm uses three 500-pound, crucible-type furnaces made by the Fischer Furnace Co., Chicago; two 500-pound, crucible type furnaces manfactured by the Anthony Co., Long Island City, N. Y.; six crucible pit furnaces with a capacity of 500 pounds each, and one electric furnace built by the Detroit Electric Furnace Co., Detroit, which has a capacity of 1000 pounds per charge.

As stated previously, the melting department is located in the middle of the old foundry bay. The arrangement of some of the furnaces may be seen in Fig. 3. Melting and pouring temperatures are checked with pyrometers manufactured by the Hoskins Mfg. Co., Detroit, and the Illinois Testing Laboratories Inc., Chicago. Test bars from each heat are sent to the laboratory, which will be described later, for chemical analysis or determination of physical properties, as the case may be.

### Make Many Cores

Cores are made in a well-lighted department having an area of 8500 square feet, and shown in Fig. 4. Sand for the cores is mixed in two sand mixers built by the Standard Sand & Machine Co., Cleveland. The cores are made by hand, by a core-blowing machine built by William Demmler & Bros., Kewanee, Ill., or by other type core machines made by International Molding Machine Co., Chicago; Wadsworth Core Machine & Equipment Co., Akron, O., and the American Foundry Equipment Co., Mishawaka, Ind. The cores are baked in three gas-fired ovens in which the temperatures automatically are controlled by recording-type, pyrometric control apparatus manufactured by the Wilson-Maulen Co., New York.

*Fig. 8—Numbered Compartments on the Shelves Make It Easy to Locate the Desired Pattern*

Castings are cleaned in a room with an area of 3700 square feet, a part of which is shown in Fig. 5. This illustration shows the band saws of which five are used in sawing gates and sprues from the castings. Gates on small castings are removed by two sprue cutters. Pneumatic chippers made by the Independent Pneumatic Tool Co., Chicago; Ingersoll-Rand Co., New York, and the Chicago Pneumatic Tool Co., New York, are used on larger castings. Four stand grinders made by the Norton Co., Worcester, Mass., and portable pneumatic grinders made by the Warner Swasey Co., Cleveland, are used for grinding. A sandblast barrel built by the L. O. Koven & Bro. Inc., Jersey City, N. J., also is included in the cleaning room equipment.

After the castings are cleaned, they are forwarded to the inspection department, a view of which appears in Fig. 6. As may be seen, the castings are transported in wooden boxes mounted on swivel wheels. Since many of the castings produced in the foundry of the Lumen Bearing Co. are required to possess a definite hardness, a brinell hardness testing machine, shown at the right in Fig. 6, is installed permanently in the inspection department. The castings are brought into the inspection room and placed on the benches several of which may be seen in the illustration. The inspectors then examine each casting for defects. Defective castings are sent to the scrap room where they are placed in bins according to their analysis, and are remelted. Good castings are forwarded to the shipping department, occupying 3000 square feet of floor space, where they are arranged for shipment.

### Have Pattern Storage

A pattern shop adequately equipped to turn out patterns according to specification is operated in connection with the plant. Part of the shop is shown in Fig. 7. Machinery in the shop includes a planer made by the Fay & Egan Co., Cincinnati; a band saw made by the Crescent Machine Co., Leetonia, O., and several lathes made by the Oliver Machinery Co., Grand Rapids, Mich., Motch & Merryweather Machine Co., Cleveland, and Henry Prentiss Co., Buffalo. Fig. 8 shows the pattern storage. This department is constructed of reinforced concrete, and as a further protection against fire is equipped with an automatic sprinkler system. The method of storing the patterns easily may be distinguished by examining the illustration. The racks in the center of the room are constructed of iron pipe and angle bars. Wooden shelves are supported on the bars. The bins are arranged against the wall. Each compartment is numbered, and when a

*Fig. 7—A Well Equipped Pattern Shop Enables the Production of Patterns Conforming to the Foundry Practice Used*

pattern is placed in one, the number is recorded on the pattern card. This method makes it easy to locate any pattern in storage.

Many of the castings produced by the Lumen Bearing Co., must answer definite chemical analyses or possess certain physical properties, and some must meet both of these requirements. A laboratory equipped to run the proper tests is maintained. A certain amount of research work is carried on in this laboratory in addition to the routine control tests. At present investigational work is in progress on the effect of high temperatures on nonferrous alloys. Apparatus in the chemical laboratory includes that necessary for conducting the analyses for the various elements in brass and bronze or other alloys. Copper and lead are determined by the electrodeposition method in a nitric acid solution containing an accurately weighed amount of the alloy. The electrolytic apparatus used in the determinations employs the principle developed by Frary for agitating the solution. This method uses a hollow iron spool containing a large number of turns of wire. The beaker containing the solution is placed in the center of the hollow spool, and the electric current passing through the coil develops a high magnetic flux which in turn causes a thorough agitation of the solution in the beaker. The rapid agitation increases the speed of deposition to a high rate, and consequently shortens the time to a great extent.

### Examine Alloy Structure

Other apparatus in the laboratory includes a testing machine built by the Tinius Olsen Testing Machine Co., Philadelphia, for determining the tensile and compressive strengths of materials, metallographic equipment for microscopic examination of metals and alloys, hardness testing machines, apparatus for determining the coefficient of expansion of metals, and a core testing machine. One of the interesting features of the metallographic equipment is the specimen polishing machine. This machine has several horizontal, rotating disks to which the various grinding and polishing mediums may be affixed. This feature is similar to several machines on the market. However, the Lumen company's machine differs in that the specimen is held mechanically under a definite pressure by a moving arm that sweeps slowly back and forth across the disk. This device is claimed to allow rapid polishing of large sections without surface flow. Areas as large as 4 square inches are said to be polished in approximately 3 hours.

Supplementing the usual machines for determining brinell and scleroscope hardness, M. A. Bierbaum, vice president of the firm, developed a hardness testing device which employs a hard jewel possessing a definitely shaped cutting edge. This jewel under a definite pressure is drawn across the specimen and leaves a cut in the surface. The hardness of the material is gaged by measuring the width of the cut microscopically. In hard metals and alloys the cut is narrow, and in soft materials it is wide. It is claimed that the device is extremely useful in determining the hardness of metals and alloys containing hard and soft constituents in the same matrix.

### Reclaim Metals

A reclamation plant for recovering the metallic content of the ash and spills from the furnaces is operated in connection with the foundry of the Lumen Bearing Co. The system employed is that developed by James and separates the metal content from the waste by the use of hutches and concentrating tables. The ash and spills are placed in a jaw crusher that pulverizes them to about 1-inch size. The crushed material then is elevated to a storage tank. From the storage tank it passes into a ball mill after water is added. The ball mill grinds the material to about 50-mesh size forming what are known as sands and metallics.

From the ball mill, the watered material passes over two screens which separate the product into coarse and fines. The coarse material goes to the hutches where the water is kept constantly agitated by a piston. The pulsating movement of the water causes the lighter sands to remain in suspension and thus be carried off in the overflow which returns to the ball mill. The heavier metallic content sings to the bottom of the device known as the hutch from which it later is removed. The fines previously mentioned are sent over a wilfley concentrating table which separates the product passing over into concentrates and tailing or waste material. The concentrating table is mounted at a slight angle and its surface contains a large number of narrow ribs which project about ¼-inch above the table. An eccentric gives the table a horizontal motion and causes heavy, metallic particles to move across the table in the direction of motion into a trough at the edge. The light particles or tailing containing ½ to 1 per cent metals pass down the table at right angles to direction of motion. The tailing is dewaterized and sent to the waste pile. Concentrates either are sold, melted into ingots, or used as scrap additions to metal charges.

Turnings obtained from purchasers of the company's castings are run through a magnetic separator made by the Dings Magnetic Separator Co., Milwaukee, to remove any iron. The cleaned turnings are melted and cast into ingots. The Lumen Bearing Co. also produces phosphor bronze and manganese bronze ingots, and these are alloyed in furnaces made by the United States Smelting Co., New York, and the Monarch Engineering & Mfg. Co., Baltimore. Both furnaces are oil fired and have capacities of 2000 pounds. For producing white metal alloys the firm uses 5-pot type, oil-fired furnaces. Four of the furnaces have capacities of 800 pounds each and one will melt 3000 pounds of metal.

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## Gives Data on Expansion of Fireclay Brick

The University of Illinois, co-operating with the utilities research committee, composed of representatives of various public utilities, has published a bulletin on the thermal expansion of fireclay brick. The apparatus used consists of a square, rigid, water-cooled, metal frame; fused-silica end pieces; a dial gage; a water-cooled radiation shield; and the specimen. It is so arranged that in the middle of the framework two fused silica blocks are placed vertically one above the other, forming a column by the insertion of the test piece between the blocks. On both ends of the column is a small block into which the column fits. At the upper extremity of the column and bearing upon one of the blocks is the dial gage held rigidly in position by a thumb screw. The dial gage is protected from the heat of the furnace, which surrounds the specimen and the two fused-silica pieces, by a water cooled radiation shield. As the sample is heated, the expansion is registered on the dial gage and from this figure the expansion of the brick specimen is computed.

The bulletin is prefaced with tables and references to the work of other investigators. It gives a description of the apparatus used, shows curves of the results of tests, drawings of the apparatus, and many data on the relation of thermal expansion to mineralogic composition and chemical analysis. The conclusions reached and a summary of the investigation are appended. This booklet is issued as bulletin No. 181 and may be obtained for 20 cents by addressing University of Illinois, engineering experiment station, Urbana, Ill.

# Cast Iron Stages a Comeback

*Speaker at Newark Foundrymen's Joint Meeting with Eastern Engineers Defends Record and Announces New Properties of Gray Iron*

THAT gray iron is on the way to regain its former position in the metal working industry was the assertion of J. W. Bolton, metallurgical engineer, Lunkenheimer Co., Cincinnati, speaking at a recent joint meeting of the Newark Foundrymen's association and the metropolitan section of the American Society of Mechanical Engineers.

Mr. Bolton's paper, entitled "Gray Iron: An Engineering Material," was greeted with enthusiasm by one of the largest gatherings ever assembled for a local function of this character.

Mr. Bolton discussed the questions: What does gray iron offer the engineer and how will a foundryman offer the engineer what he needs? He finds that gray iron castings are being made with a degree of uniformity and soundness not exceeded by any cast product. Today they may be obtained with a tensile strength anywhere from 20,000 to 60,000 pounds per square inch. Excellent and easy machining grades corresponding to the American Society for Testing Materials high test specifications are made by many responsible foundries. Other lower strength irons have a wide field of usefulness.

Low carbon high strength irons resist shock far better than the weaker varieties. The fatigue limit stress of gray iron may be 33 1/3 per cent of their ultimate strength. Gray iron has high hardness, compared to its machinability. Wearing properties are exceptional and deserve more attention from designers. Better grade irons maintain their strength and hardness well at elevated temperatures. Such irons are not subject to growth at temperatures under 800 degrees Fahr. for some conditions. The 450 degree Fahr. restriction seems unfortunate when applied to better grades of iron.

Gray iron resists some types of corrosion such as concentrated sulphuric acid and various caustic liquors. Easy machinability of gray iron has lead to some abuses. Close grained tough iron naturally cuts a little harder than inferior grades. Considering its strength and hardness, gray iron machines readily as compared to some other materials.

The foundryman should know more about his own product to enable him to market it more intelligently. There are many grades of cast iron, and too little information available on any of them. The foundryman has a real sales problem before him. The engineer needs more accurate and detailed information. It is up to the founder through his technical and trade associations to furnish the proper data. To do this costs money, and a pennywise pound foolish attitude is not going to advance the industry.

### Obtain Greater Uniformity

Discussing the sharp improvement in the reliability of gray iron castings during the past 20 years and particularly during the last ten, Mr. Bolton stated that this betterment is due in a large measure to the greater uniformity obtained by mixing by analysis and checking by physical test. With foundries in greater number employing trained metallurgists and in a number of cases maintaining their own laboratories, they have been able to obtain a high degree of uniformity.

Illustrating his remarks with stereopticon views, the speaker stated that the most important development of recent years is amplified information concerning the relationship of the graphitic carbon to the mechanical properties of the iron. The occurrence and effect of the carbon offers one of the most difficult problems with which the modern metallurgist must deal. However the practical conclusion is simple and that low total carbon irons are strongest, toughest and most dense.

The speaker warned foundrymen not to forget that it is not always the best material that the engineer wants but rather the material which fully satisfies service demands at the lowest cost.

Foundrymen refer to strength and elasticity in terms of breaking load and deflection of an arbitrarily selected arbitration bar. This, the speaker declared, is not sufficient for the engineer, who, in design must know what is the strength of the metal in the castings. The problems of cast iron appear complex, but today it is possible for the engineer to obtain a sufficiently close idea of the mechanical properties of the iron which he wants in certain castings. It is even possible to correlate test bar results to the properties of the metal in castings.

Leading investigators are coming to the conclusion that proportionality of stress to strain is only relative and undue alarm need not be felt if reasonable working stresses are not exceeded. It is well known that many cast iron parts have been subjected to stresses which are a respectable percentage of their ultimate tensile strength and have given useful service under such conditions for many years. He suggested that it is possible that the mechanical properties of gray iron improve under many actual service conditions and that if initial set is not objectionable the usual stress resistance may be a high proportion to the initial test breaking load.

While lack of ductility and comparatively low resistance to high impact is quite well known, the speaker declared the actual significance of this in every day practice is somewhat overrated. He believes also that the statement that cast iron is brittle has received more than its share of attention. He cited prominent authorities to show that gray iron has good resistance to fatigue and declared that the structure of gray iron, being quite hetereogeneous offers and excellent bearing surface at either room or elevated temperatures. It is particularly free from tendency to grab or seize.

## Made Agent for Coke

The Debevoise-Anderson Co. Inc., New York, which recently moved its headquarters from 114 to 117 Liberty street, New York, has been appointed agent of the Philadelphia Coke Co. for the sale of by-product coke for metallurgical and foundry purposes. Sale of the coke will be handled largely from the company's branch office in the Stephen Girard building, Philadelphia. The Debevoise-Anderson Co. Inc., also has opened a branch office at 902 Chapel street, New Haven, Conn. from which it will conduct the sale of by-product foundry and metallurgical coke made by the Connecticut Coke Co., New Haven, Conn.

# Presents Theories On Graphitization-II

By H. A. Schwartz

IN THE case of the metal manganese, moderate concentrations of the element do not affect materially the graphitizing rate above $A_1$ but substantially prevent it below that temperature. Accurate data are lacking but experiments in the author's laboratory have shown that although the $A_1$ in both the stable and metastable system is lowered by manganese, the former falls more rapidly than the latter. If extrapolation may be relied upon, then $A_1$ stable will be below $A_1$ metastable for concentrations around 1¼ per cent manganese which is of the order of magnitude of the concentration inhibiting graphitization below $A_1$. The $A_1$ line of iron-carbon diagram is known to disappear for low carbon contents, since carbon is slightly soluble in alpha iron, or ferrite. It is not unlikely, by analogy with the eutectic line that a lower transformation point is accompanied by an increased solubility of carbon in alpha iron and hence that in irons containing more than this critical concentration of manganese the Fe-Fe$_3$C system may be stable below $A_1$.

### Do Not Know Conditions

We as yet do not know thoroughly the conditions of graphitization in the presence of all the other elements which affect graphitizing rate. In a study of the element nickel, the results of which are offered for publication elsewhere, but which has not been printed as this is written, certain significant observations were made. It was found that silicon was inactive in promoting graphitization in the presence of rather small amounts of nickel (about ¼ per cent or more). In such alloys the graphitizing rate was determined solely by nickel content and strangely enough, approaches zero with decreasing nickel concentration.

It was also shown that although the thermal coefficient of graphitizing rate is about the same as in the case of silicon, the relation of graphite formation and time approximates, the graphite being proportional to the 2/3 or 3/4 power of time and this relation persists until the reaction is nearly complete.

No detailed explanation of the mechanism of graphitization consistent with these facts has yet been worked out. However, it is evident that the mechanism must be different from that in the presence of silicon. Also we learn from this study that the effect of the sum of a number of variables affecting graphitization is in no sense the algebraic sum of the several effects.

A point of interest and perhaps of significance in connection with the relation of silicon and nickel in producing graphitization is found in certain density experiments in this laboratory.

Reference has already been made to the location of carbon atoms in solid solution in iron. It is obvious that for elements of lower atomic weight than iron, such as carbon or silicon, the solute must increase the density of additive solutions and decrease that of substitutional ones.

It has been shown in this laboratory that for solutions in gamma iron at room temperature silicon increases the density if the gamma phase is rendered stable by manganese but decreases it if nickel is the stabilizing agent. Thus in the presence of the latter element silicon seems to occupy the location in the space lattice characteristic of the carbon atoms in stable solution and hence hardly can be expected to favor the location of carbon atoms in similar positions.

We come now to another question of great importance in practicing the art of graphitization. Although all systems tend to so rearrange themselves as to give out a maximum of energy, they are not always able to do so. Thus a mixture of hydrogen and oxygen will remain quiescent indefinitely until ignited and then combine violently to form water.

### Does Not Change State

We have seen that probably at all temperatures, the compound Fe$_3$C wishes to separate in some ways into the constituent elements and yet we know that white iron remains unaltered indefinitely at room temperature. The author has in his possession white iron of various cooling rates which is now about 27 years old and in which no trace of graphitization is detectable microscopically.

It may be calculated from the observed thermal coefficients that some centuries might be required to yield measurable amounts of free carbon at room temperatures in ordinary white cast iron. On the other hand the author has observed some materials containing special alloying elements in which there is some indication of the progress of graphitization at room temperature in a year's time. However, this work is not yet conclusive.

Aside from the effect of temperature in promoting the mobility of the atom required for graphitization there are reasons why graphitization may not begin even under conditions under which it will proceed with fair speed.

Cementite is distinctly denser than is the mixture of iron and carbon resulting from its decomposition. Therefore, there is an increase of volume accompanying graphitization and the carbon nodules are under the necessity of stretching the metal in which they grow to make room for themselves. It readily can be calculated that less mechanical work will be done per unit

## Applies Principles

*IN THIS concluding part of his article the author refers to the effect of nickel on graphitization, and gives some possible causes for the start of crystallization of graphite. The effect of some gases on graphitization also are discussed, and then the scientific principles previously mentioned are applied to practice.*

volume of carbon precipitated the larger the individual mass of graphite upon whose surface this unit volume is precipitated. This means that large nodules of free carbon will grow at the expense of small ones and in part perhaps explains why in the ordinary white cast iron graphitization progresses by an increase in size, rather than in number, of graphite nodules.

The occurrence of the first infinitely small graphite nodule in a mass of solid iron theoretically requires an infinite amount of work per unit volume to expand the iron and hence the beginning of graphitization in a perfectly homogeneous metal phase is theoretically impossible. That graphitization can begin at all, in practice, is probably due entirely to the non-homogeneity of the metal.

### Residual Graphite Exists

If there exist in the solid metal any inclusions of crystal habit such that graphite can crystallize upon them, graphitization is accelerated in proportion to the number and volume of these inclusions. Graphite itself, persisting from flakes not dissolved in the molten condition, furnishes the best possible "seeding" or inoculaton and the work of Piwowarski, *Stahl und Eisen*, Vol. 45, 1925, on the effect of superheating molten gray cast iron, points to the possibility of such residual graphite. Failing any such inclusions the existence of fields of stress in iron may serve as nuclei for graphite crystallization. In all white cast iron at least two solid phases are present, cementite and either austenite or ferrite. At the boundary of the two phases surface tension phenomena will be present which tend to separate these boundaries where sharp angles exist and thus produce internal tensile stresses favorable to the crystallizing out of graphite.

Indeed it seems more than likely that the first occurrence of graphite is generally at the surface of cementite and certainly never within that constituent. This consideration also contains, perhaps, the difficulty of starting graphitization in material containing much less than 2 per cent carbon which at any temperature (above $A_1$) at which graphitization might be fairly rapid, are composed of a single solid phase.

The mechanical work which must be done so that cementite may decompose in solid iron, introduces another interesting subject upon which we can as yet but speculate. Decomposition of cementite is accompanied by the liberation of a given amount of energy, a portion of which is expended in expanding the metal in which the graphite grows. In addition to the relation just pointed out between the size of graphite particles and the energy required for expansion, there is another variable of importance.

### Behave Like Viscous Liquids

It is well known that all the metals, at high temperatures, behave like viscous liquids. They continue to flow at a constant rate proportional to the force applied. Therefore, if an attempt be made to accelerate graphitization we increase the rate at which we require the iron to stretch, hence the stress, and consequently the work required to produce a given increase in volume at a given temperature. This work is done only by the liberation of energy from a given amount of cementite and hence can not exceed a definite amount. This limitation may prevent graphitization proceeding more rapidly than some fixed maximum value, for any given size of graphite nodules. We still lack many of the data requisite for giving the relation a precise mathematical form.

The number of centers of crystallization, or carbon nuclei, is determined by laws which as yet are understood incompletely. The considerations already advanced point to a distinct relation between the fineness of distribution of cementite and the number of carbon nodules formed, per unit volume.

It is also generally true, Fisher, *Transactions*, American Foundrymen's association, Vol. XXX, that at high temperatures more centers of crystallization exist in a given metal than at low temperatures.

Reference already has been made to the fact that in ordinary white cast irons there is little increase in number of nodules with time. In other words all the potential centers develop at once. In the case of nickel alloys however, the reverse is approximately true and nodules increase in number but do not grow much in size, reaching their final dimensions quickly. Also, there is but little growth of large nodules at the expense of small ones, as required by theory, on holding metal at constant, elevated temperature. However, a lowering of the temperature to a new constant value frequently increases the size, and decreases the number of nodules.

Reference has already been made to the work of Hayes and associates showing that graphitization is accelerated by increase of pressure if occurring in a CO-$CO_2$ atmosphere. Their conclusion is largely accomplished by the sum of the two reactions as follows:

$$Fe_3C + CO_2 = 3\ Fe + 2\ CO$$

and

$$2\ CO = C + CO_2$$

The atom thus migrating in the gas phase and not at all through the metallic iron lattice.

The relation between furnace atmosphere and graphitization has been studied in the author's laboratory and some rather interesting results observed which confirm the conclusion that such reactions play a part in the mechanism of graphitization.

Thus in neutral gases such as nitrogen and argon, as well as in vacuo, graphitization is possible but rather slow. In $CO_2$—CO it is accelerated but if either constituent is continuously removed chemically the reaction is about as slow as in neutral gas.

Two reactions

$$Fe_3C + 2H_2 = 3\ FE + CH_4$$

and

$$CH_4 = C + 2H_2$$

could and do cause graphitization as in the case of CO—$CO_2$ mixtures. However, in pure hydrogen the reaction is not rapid though more so in $CH_4$. In acetylene it is exceedingly slow probably because that gas decomposes directly into carbon and hydrogen at the temperatures involved so that we are working practically in hydrogen. Moist gases are usually more active than dry ones which suggests that the reaction products of the oxygen of steam are of importance.

### Studies Related Phases

It is well in this connection to consider also that gas reactions may be of considerable importance in the study of graphitization. If at a given temperature and pressure, $CO_2$ can burn the carbon of cementite and CO decompose into $CO_2$ and carbon, then at the same temperature and pressure $Fe_3C$ also must dissociate into its elements, and carbon as $Fe_3C$ must be more soluble than as the element. If this were not so we could create or destroy energy by first forming $Fe_3C$ by one reaction and then destroying it in the same environment by another.

Also it is necessary that the vapor pressure of carbon from a saturated solid solution in iron must be identical with that of the element at the same temperature, or else if the two were in the same enclosure carbon would pass from the phase of highest vapor pressure to the other and the solution would change concentration in contact with the solute and hence not be originally saturated. The vapor pressure of carbon from $Fe_3C$ and from solid solutions saturated with respect to carbon must be similarly identical and if $Fe_3C$ be metastable the vapor

pressure of carbon from the compound must be greater than that from the element. These matters are self evident to the physical chemist but are not always rcognized in America by the metallurgist. A clear comprehension of the matter will prevent vain experiments in attempting the reversal of a reaction by purely environmental changes.

### Feature Must Be Considered

If, for example, it once can be shown clearly that $Fe_3C$ is metastable, i.e. desirous of dissociating, at all temperatures below the solidus then it is impossible that the line marking the solubility of carbon in the equilibrium diagram for the stable system can ever fall to the right of the corresponding line in the metastable diagram, a point worthy of consideration by those proposing modifications of the present equilibrium diagrams.

Also any alloying element which renders $Fe_3C$ stable, as distinguished from retarding graphitization rate, must ipso facto, increase the solubility of carbon more rapidly than that of cementite and must also alter the gas equilibria in such a manner that carbon is more combustible as the element than as the compound present. In all these matters we must distinguish clearly between the direction of the graphitizing reaction and its velocity. Thermo-dynamics deals only with the former.

We may now turn to the application of the scientific principles so far discussed to the practice of the iron foundryman. Quite obviously the gray iron foundryman wishes to promote a certain definite degree of graphitization during cooling in the mold and the malleable foundryman wishes to produce no primary but complete secondary graphitization.

Since for a given character of graphite flake the physical properties are determined predominately by graphite content, both will first strive to control carbon concentration in the liquid metal. The gray iron foundryman, confining himself largely to cupola melting, is here at a disadvantage for he can produce only a concentration which is near the solubilty of carbon in liquid iron at his metal temperature and hence also unavoidably is confronted with a carbon content increasing with increased melting temperature. For this reason, in America, the cupola has been abandoned as a melting furnace for high quality malleable and melting is conducted in some manner in which liquid metal is not kept in contact with an excess of carbon. It is then possible to exercise fairly close control over the desired carbon content by suitable selection of the metal stock to be melted.

Acceleration of graphitization with increasing temperature causes the reaction to be so rapid above say 100 degrees Cent. that during cooling in the mold to this temperature much graphite may separate especially if the composition of metal be favorable and the cooling rate slow, as in large castings. The gray iron foundryman thus works with rather high silicon metal and the malleable foundryman with rather low. Except in the case of large sections, cooling rates are such that no great amount of graphitization ever occurs at temperatures much below 1000 degrees Cent. Therefore, the gray iron foundryman can not produce a casting of lower combined carbon than the saturation point of his iron for carbon at about 1000 degrees Cent. An increase in silicon content, decreasing carbon solubility, thus will decrease the combined carbon in gray iron independently of its effect on graphitizing rates.

### Graphite May Separate

The malleable foundryman will wish to graphitize his graphite-free castings completely and as rapidly as possible but will desire to keep the free carbon in reasonably nodular form. He first will choose a silicon content as high as possible without producing primary graphitization. He will heat the casting as rapidly as possible to the highest temperature convenient which will not render the casting so plastic that flakes of graphite may grow. About 900 to 925 degrees Cent. is probably the upper limit from this viewpoint. He will keep his castings at this temperature until all cementite has been destroyed by dissolving in iron and crystallizing as carbon. He then will cool the castings to below the $A_1$ point, where carbon becomes insoluble and keep them at a constant or slowly decreasing temperature below this point and high enough to permit fairly rapid graphitization till the remainder of the carbon has all crystallized out and thereafter will cool as rapidly as convenient.

It is well known that quick cooling from a temperature a little below $A_1$ after completion of graphitization is advantageous. Marshall, United States bureau of standards technical paper No. 245, has published on this point.

It is fortunately desirable to carry on the reaction in an atmosphere of $CO$-$CO_2$. This atmosphere not only helps graphitization rate but also can be caused to protect the casting from surface oxidation. Contamination of the desired atmosphere can be prevented best by packing castings in iron containers in a refractory powder of such character as to be in equilibrium with a gas phase richer in CO than that in equilibrium with the lowest oxide of iron. The ferrous silicates are convenient for this purpose and the use of the higher iron oxides, is carefully avoided.

### Helps Graphitization

There is no need of decarburization, as in the old process of Reaumur, for the black interior portion has the properties desired by the consumer, especially machineability, to a greater extent than does the surface. Were a packing available which prevented decarburization its use would be desirable if unattended by any other difficulty.

The use of higher iron oxides as packing, coats the casting with a skin of oxide which occasionally is reduced to metallic iron by a change in atmosphere and then becomes a thin detachable sheet of nearly pure iron which is undesirable on commercial castings. Also atmospheres which will contaminate the metallic portion of a casting with oxygen are a possible cause of difficultly machineable, pearlitic or steely rims sometimes called *picture frames* in America. These possibly arise from the probable circumstance that $Fe_3C$ is stable and not metastable towards iron oxides and carbon.

The author is fully conscious that he has not, in this communication dealt conclusively with any portion of the subject matter nor exhaustively with the problem as a whole. The purpose has been to compress into a paper of reasonable length a summary of some of the principal factors requiring consideration in any real scientific study of the phenomena of graphitization. It has seemed inexpedient to enter upon manufacturing methods in view of the necessarily great differences in operating conditions in France and the United States. Apologies are further due for the fact that the references are drawn largely from other than French sources. An American student naturally is most familiar with the technical literature of his own country and next with other publications, English and Japanese, in his own language. It happens that the author reads German more readily than French, hence he may have neglected unintentionally much work by French scientists to which reference should have been made.

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W. R. Evans, Cambridge university, England, world authority on corrosion will lecture in America next February as guest of the institute of metals division of the American Institute of Mining and Metallurgical Engineers.

# QUERIES ON FOUNDRY PRACTICE

*Suggested Solutions for Common and Unique Shop Problems*

## Thin Iron Casting Leaks Under Pressure

QUERY

We have a heavy discount on a gear case shaped somewhat like a pail 6 inches diameter, 11 inches deep, ⅛-inch metal thickness with heavy bearing bosses on the bottom. Many of these castings although apparently perfect, show a slight leak when subjected to a gasoline test. A small, black, spongy area is disclosed when the casting is broken. Can you tell us the cause of this defect and how to prevent it?

ANSWER

The defect in this casting is caused by a slight amount of foreign material, loose sand or dust, carried into the mold with the stream of iron. It is caught and chilled between the thin walls of the mold. The obvious remedy is first to take every possible precaution to prevent any loose dirt from floating in with the iron, second, provide a ring of gates completely around the casting so that it will fill rapidly. Perhaps a third precaution should be added, pour the casting with exceedingly hot iron.

## Melt Sash Weight Iron

QUERY

We are contemplating the manufacture of sash weights in iron molds and pouring them with metal secured by melting No. 2 busheled scrap. Is a special cupola required for melting this kind of material?

ANSWER

A special cupola is not required to melt steel scrap, unless you propose to keep it in blast all day or even for the greater part of the day. For short heats the scrap may be melted in any type of cupola provided the cupola man is an expert and can secure an exceedingly high temperature. The metal is *dead*, which means that it sets rapidly and although melted at a high temperature it must be handled quickly. The usual allowance of coke and limestone must be increased. The extra coke to insure higher temperature and the extra limestone to take care of the slag. A comprehensive description of melting all steel heats in the cupola was presented at the foundrymen's convention held in Detroit in 1926. The paper prepared by T. F. Jennings was published in THE FOUNDRY, Oct. 1, 1926 and also is available in the *Transactions* of the American Foundrymen's association for that year.

## Loam Mixtures Used in Steel Foundries

QUERY

Can you give me a good loom mixture for both gray iron and steel. Are loom molds made in the steel foundry?

ANSWER

The error in pronouncing this word is so prevalent and wide spread, that it seems advisable to correct it before proceeding further. The material is not loom but *loam*. Like many other words in our foundry vocabulary it originated in England where many of the vowel sounds are treated with as little consideration as the letter *h*. The best loam is not an artificial mixture, but a natural product of a coarse, open grained sand strongly bonded with clay. This material is used extensively as a dry sand facing and when necessary it is mixed with water to the consistency of mud and then it becomes loam.

Any kind of molding sand may be used to make a loam mold, but unless it possesses certain characteristics it will not prove satisfactory. For example it must be highly refractory and also must present two apparently contradictory features, high permeability and high bond. That explains the lack of general knowledge and the air of mystery which surrounds loam mixtures. The only reasons they are mixtures is because in some instances a binder must be added to straighten the sand and then additional foreign material must be added to open the sand so that the gas and steam may pass through it freely. From the foregoing it is apparent that no standard loam mixture exists. The mixture used in any locality depends on the character of the sand that is available.

Loam molds find little favor in American steel foundries where large and intricate jobs are built up with a collection of dry sand cores. Occasionally a large propeller blade or similar casting is made in a loam mold and in these instances the regular facing is used. It is converted temporarily into mud for convenience of application.

## Shot Iron Not Cause of Pits in Enamel Ware

QUERY

After our sand is in use for some time a great many small hard lumps like the enclosed samples, begin to appear. Can you tell us the cause of the formation of these pellets. We think they are responsible for many of the defects especially on castings that have to be enameled. In the cleaning process the sandblast at 100 pounds pressure exposes porous spots and pits on the surface of the castings and render them unfit for enameling.

ANSWER

The little pellets which you submitted for examination are iron coated with a thin film of clay from the sand in which they were buried and therefore might deceive the inexperienced into believing that they are a natural product of the sand pile. If you had placed them on a flat piece of iron and hit them with a hammer (as we did) you would have seen the film fall away like the thin covering on each of the kernels in a peanut, leaving a small round iron shot exposed. In a few instances the pellets were formed of slag and crushed readily under the hammer, but the glistening brown fragments revealed the material as ordinary slag.

In the natural process of pouring off a heat in a foundry a certain amount is bound to fall on the floor or splash over the top of the molds. Some of this iron sets to a shape and size that readily may be recovered. A considerable portion splashes on the floor and immediately separates into a myriad of small particles, locally known among foundrymen as *shot* iron. It becomes incorporated in the sand pile during the subsequent preparation of the sand. Spilled slag acts in the same manner.

Presence of either kind of shot will produce a rough raised spot in that vicinity on the casting, but they are not responsible for porous areas or pock marks. These are caused by dirt in the metal, either carried in with it or picked up in the mold. A close examination of the defective spots with a microscope will show whether the foreign material is slag or sand. Indeed in many instances the character of the material may be determined by the naked eye.

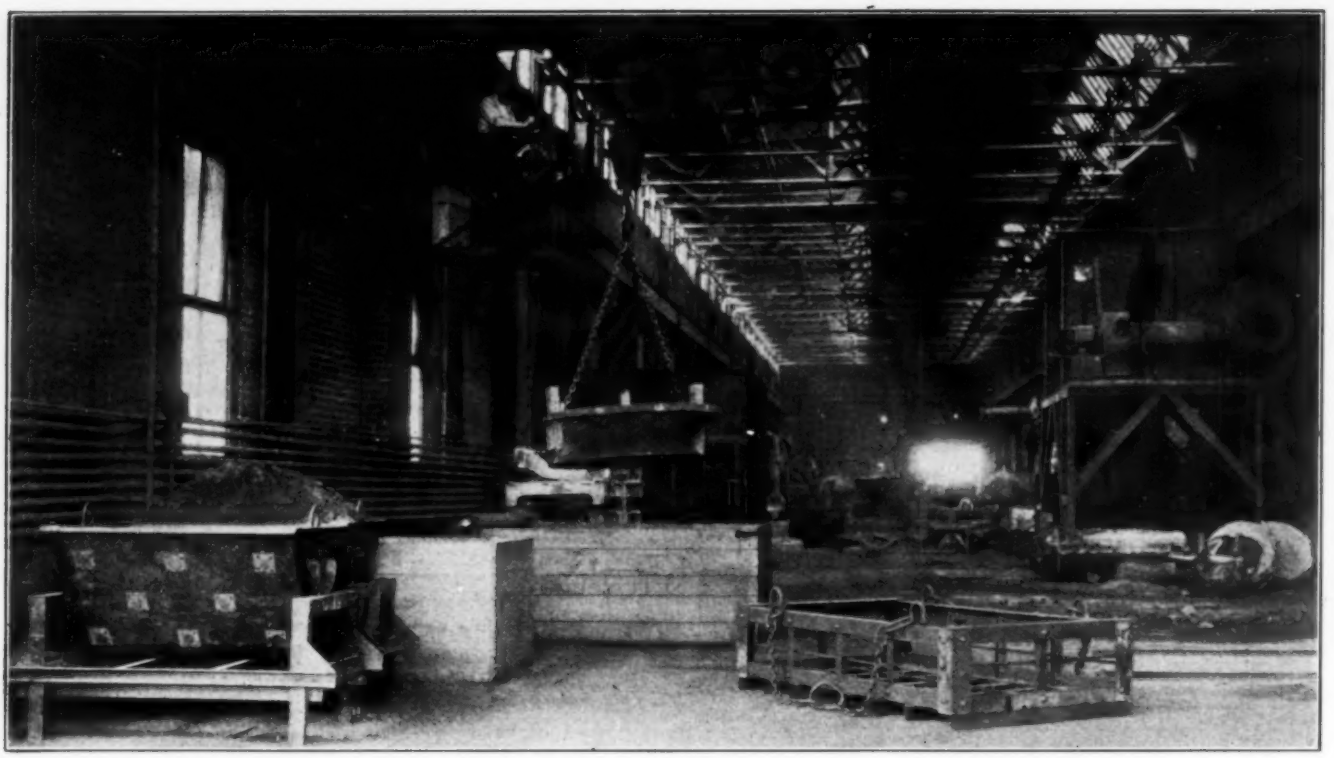


Fig. 1—View of cleaning room showing crane lowering casting through opening leading to the washroom in the basement. Small castings are loaded in the frame shown to the right

# Removes Cores Hydraulically

By James Prendergast

WHETHER or not to adopt a hydraulic method for cleaning castings has been a debatable point with many foundrymen in recent years since descriptions have been broadcast through THE FOUNDRY of the methods practiced and the equipment installed at several prominent plants for utilizing this process. Unfortunately the high cost of water prevents many, perhaps the majority of foundrymen from installing a cleaning plant of this character. This is true particularly in foundries where the only source of water supply is the city mains and where the water, as waste, must be discharged into the sewer after it has served its purpose of washing the core sand from the casting. Where a reservoir can be installed to catch the waste water and where the same water can be used repeatedly, the cost of the water is reduced greatly, thus bringing the method within the grasp of almost any foundry for cleaning the cores out of medium size and large castings. While looking up data on the subject I found that the first published reference was in June, 1909. James A. Murphy, at that time foundry superintendent at the plant of Hoovens-Owen & Rentschler Co., Hamilton, O., experimented with a fire hose to wash the cores out of some of the large castings. His success in this initial work encouraged him to install a small pump by which the water pressure was increased to approximately 300 pounds per square inch. It is interesting to note that although an account of this radical departure in cleaning methods was published at the time in the technical press, no other foundrymen appears to have given the matter any consideration for many years. In fact for several reasons, which are not perti-

FIG. 2—FORMER METHOD OF DIGGING OUT CORES

nent to the present discussion, the method eventually was abandoned by the Hamilton foundry.

The next installation of which we have any record is that at the gray iron foundry of the General Electric Co., Erie, Pa., about 1920, followed a few years later by a somewhat similar installation at the plant of the Allis-Chalmers Co., Milwaukee.

Back in 1912 before either of us had learned of the early experiments, Mr. Copeland, president of the Sullivan Machinery Co., suggested to me the advisability of trying out this method in the foundry conducted by the company at Claremont, N. H. The idea did not appeal to me. I could not see how any man could do the work without becoming water soaked. A rubber suit might offer a certain measure of protection in the summer, but clearly the work could not be carried on under the severe climatic conditions which prevail throughout northern New England in the winter season.

### Install Core Breakers

The hydraulic idea was dropped for the time, but we did improve methods of removing cores by digging them out with large pneumatic hammers instead of the former steel bar and sledge hammer. This method represented quite an improvement over those formerly employed. It relieved the men of a great deal of disagreeable and laborious effort and also reduced costs in the cleaning department. This method of breaking up the cores with pneumatic tools has been adopted quite extensively in the foundry field, and I believe it to be the best way of doing the work where water facilities are not available.

Although shelved temporarily, the hydraulic idea was never abandoned, but was taken out of seclusion periodically for overhauling and general inspection. During 1926 I visited several plants where improved methods and equipment had been installed for cleaning castings hydraulically. Working conditions showed such a marked improvement and cleaning costs had been reduced so materially that I unhesitatingly recommended the adoption of the hydraulic method in our foundry at Claremont, N. H. I favored the style of installation in use at the plant of the General Electric Co., Erie, Pa., with certain modifications to suit our particular conditions. We tried it out first in September, 1927, with highly gratifying results and it has measured up to expectations consistently since that time. The annual net saving as shown later almost equals the cost of installation.

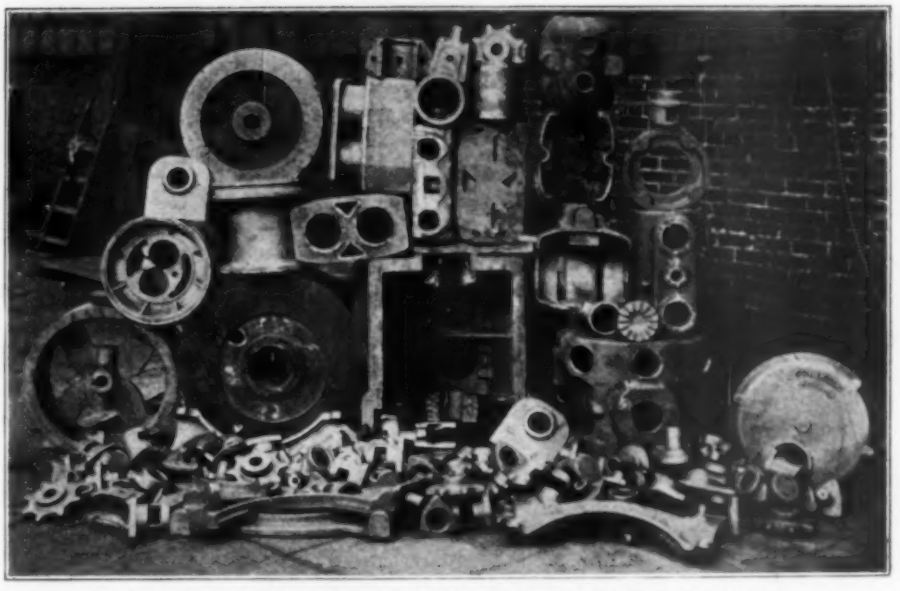


FIG. 4—RECLAIMED SAND USED FOR FACING ON THESE CASTINGS

### Wide Range of Castings

Typical castings are shown in several of the accompanying illustrations. The Sullivan Machinery Co., Chicago, operates plants at Claremont, N. H., and at Michigan City, Ind., where it manufactures stationary and portable air compressors, air and electric hoists, coal mining machinery, core drills for prospecting and oil drilling, hammer drills and concrete breakers for construction work. From the foregoing list and the illustrations it is apparent that castings are made in a wide range of sizes and that dry sand cores are employed extensively.

Layout of the plant near the river and with a basement under the cleaning room, lent itself readily to the installation of the

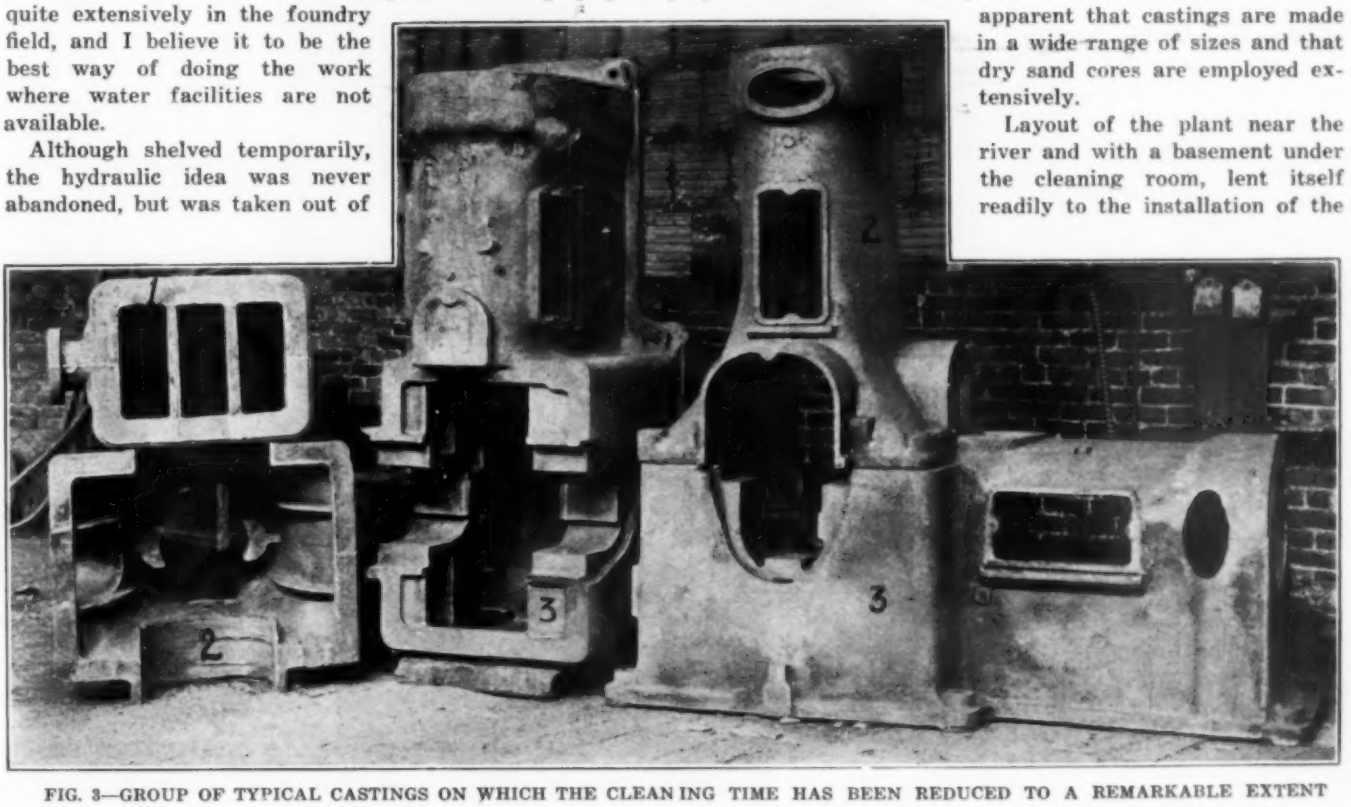



FIG. 3—GROUP OF TYPICAL CASTINGS ON WHICH THE CLEANING TIME HAS BEEN REDUCED TO A REMARKABLE EXTENT

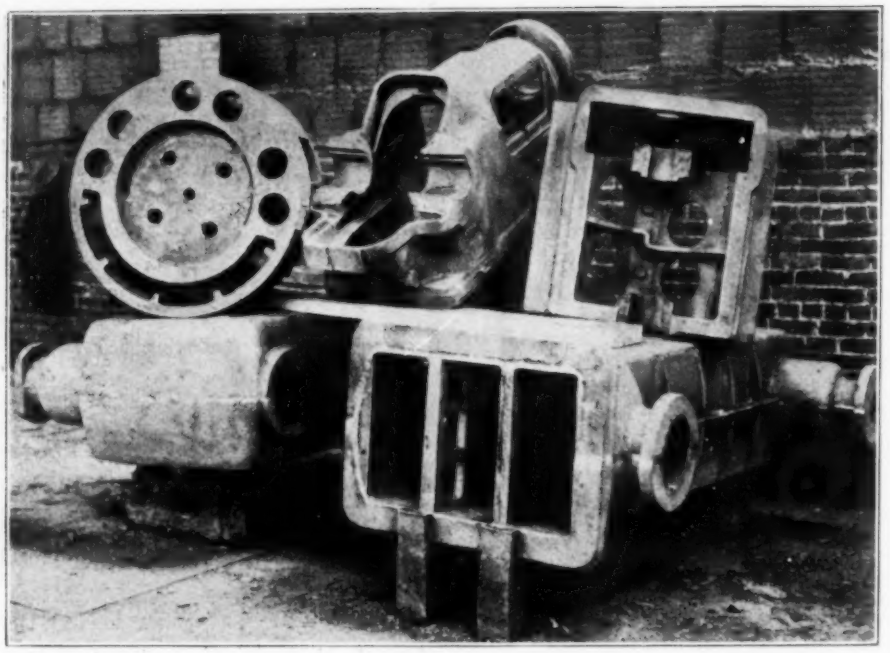


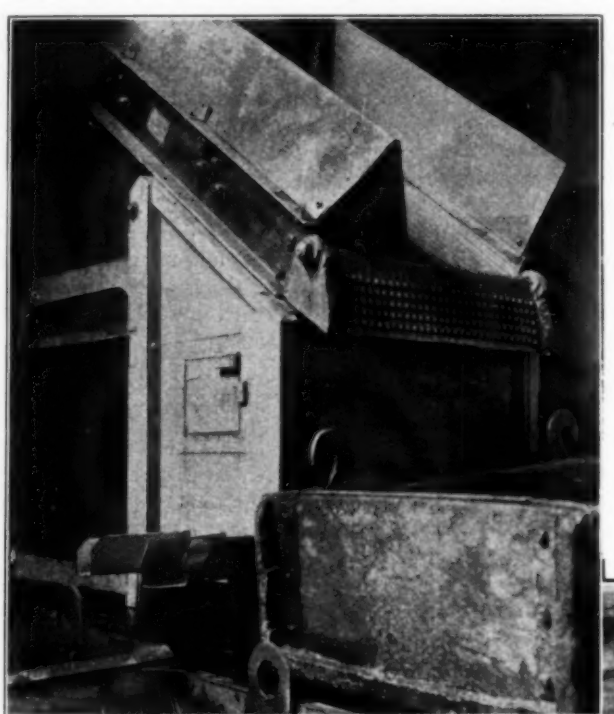
FIG. 5—CORES ARE WASHED OUT OF THESE CASTINGS WITH HYDRAULIC STREAM

new cleaning method. The castings to be hydroblasted are lowered as shown in Fig. 1, through an opening in the mean cleaning room floor, to the room in the basement set apart and equipped for the purpose. The floor of this room is considerably higher than the floor of the basement and as a result the water drops about 12 feet before it flows back into the river. Separation of fine and coarse sand takes place in this distance. Agitation of the water effects a mechanical separation and also conveys the sand to its appointed destination. The fine, burned sand is discharged with the stream of water into the river The coarse sand is reclaimed and discharged into suitable dump buckets. The process is illustrated in several of the accompanying illustrations.

Water carrying sand that has been cleaned from the casting rushes through a suitable opening in the floor to a screen which catches rods, nails and large pieces of core. From the screen it flows into a trough Fig. 6, arranged to reduce the speed of the stream and cause increased agitation and thus more effectually break up the sand on its way to a second and finer screen. This 50-mesh screen catches all the sand which we consider worth reclaiming. As it accumulates, the pressure behind forces it through a slot into a space divided in the center to direct the sand to two spouts located above two dump buckets placed there to receive it, as shown in Figs. 6 and 7. A large number of screened holes in the buckets shown to the left in Fig. 1, permit most of the water to drain out of the sand during the night. The fine sand passes through the 50-mesh screen and is carried with the stream of water and discharged into the river.

After draining all night, the sand in the dump bucket is used for facing sand for the side floor, bench and machine molders. No new sand is added. The facing mixture is made up of 50 per cent gangway sand, 50 per cent reclaimed sand with the usual amount of sea coal and approximately 1.5 per cent fire clay. This mixture is run through the muller in the usual manner. The facing is giving excellent satisfaction and shows a real saving in amount of new sand required in the foundry. A group of castings made in molds faced with this mixture is shown in Fig. 4.

Installation of hydraulic method and equipment has relieved us of the hardest labor problem with which we had to contend. The labor turnover in the cleaning department, at one time higher than in any other department, has been eliminated entirely. Accidents due to flying sand, fins and chips, formerly giving this department the unenviable reputation of having the highest accident rating in the plant, also have disappeared. We



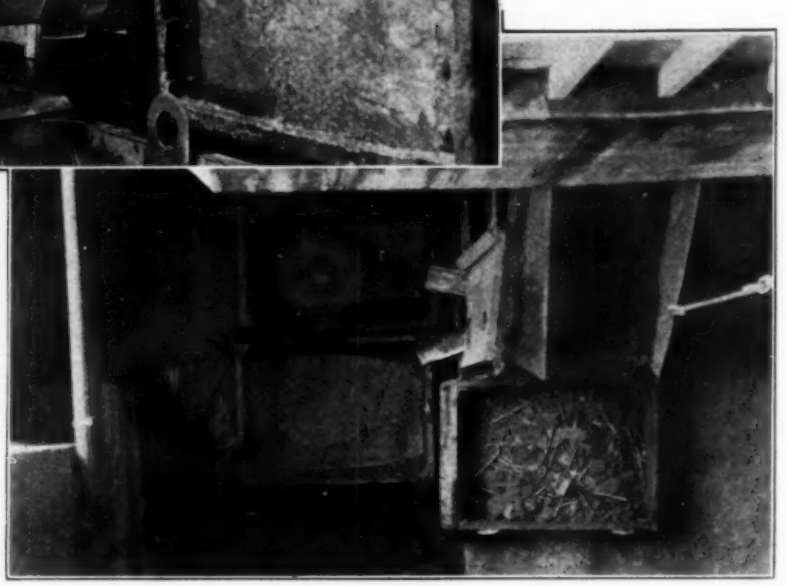


**Fig. 6 (Left)—Nails, rods, scrap and sand lumps fall into the box at the right. Fine sand is carried away with the stream of water. Reclaimed sand held on a 50-mesh screen passes through the chutes shown at the lower left into two dump buckets. Fig. 7—Looking down the shaft one may see the box for collecting nails and rods, also the two boxes for receiving the reclaimed sand**

no longer are hampered and delayed by the presence of uncleaned castings and large piles of sand and rubbish due to our inability to get men to attend to the work. Congestion and delayed deliveries are things of the past. Cores are removed in a more thorough manner than formerly, thus relieving the machine shop of considerable supplementary cleaning of pockets and corners that escaped under a former process.

**Requires Fewer Men**

The hydroblast does not do away with the sandblast altogether. However, on account of the preliminary cleaning, the work of the sandblast operator has been reduced to a minimum. One man does all the work, as compared with five formerly required.

Most of the castings are cleaned the day after they are poured. Naturally, large castings require cooling time, varying with their size and weight. It is not necessary to wait until they have cooled to atmospheric temperature. With the class of castings handled in this foundry the cleaning program never is more than one day behind.

An idea of the approximate saving effected by the new method may be gained from a comparison of the cleaning time on a typical group of castings shown in Fig. 3. Under the old method a total time of 5 hours was spent on No. 1, while Nos. 2 and 3 required a total of 8 and 15 hours, respectively. Under the hydraulic method the cores are cleaned out of the first in 20 minutes, out of the second in 30 minutes, and out of the third in 2 hours. In percentage terms the cleaning time on these three representative castings has been cut to 4, 6, and 13.3 per cent of the former time.

The wash room, 16 feet square, 11 feet high, is provided with a motor operated turntable which may be moved intermittently, or, if desirable, at a speed of 2½ revolutions per minute. A high pressure pump located below the wash room takes water from the river and delivers it at the nozzles at 300 pounds pressure and at a rate of 400 gallons per minute. The operator with his various controls, is housed in a waterproof chamber adjoining the wash room.

Two nozzles, one located above the other, afford the operator the opportunity of directing the stream of water against the casting from practically any angle. The nozzles are well balanced and therefore easy to handle. The operator can watch results closely through a heavy plate glass window located close to each nozzle. When the glass becomes obscured, the operator opens a valve which allows a stream of water from the high pressure line to squirt through a perforated pipe above the window and thus wash it clean. Controlling device for the turntable is located within reach of the operator at the nozzle.

Cost of installation, expense of operation and estimated yearly savings are shown in the following tabulation:

| | |
|---|---|
| Actual cost of hydroblast installation | $7900 |
| Annual operation expense | |
| Fixed charges (interest and depreciation) 15 per cent | 1185 |
| Power, 50,000 kilowatt hours at $0.0128 | 640 |
| | $1825 |
| Saving | |
| Labor (4 men, 10,800 hours at $0.45 per hour) | 4860 |
| Reclaimed sand (500 tons at $6 per ton) | 3000 |
| | $7860 |
| Less annual operating expense | 1825 |
| Net annual saving | $6035 |

## Overseas Group Extends Greetings to Hosts

Paris, France, Oct. 28.—(*By Special Cable*)—The annual reunion of the group of overseas foundrymen who sailed by the LANCASTRIA to attend the Second International Foundrymen's Congress in Detroit during September, 1926, was held here today. Frank Russell, General Refractories Co. Ltd., Auldam House, Workshop, acting as secretary for the group which is known as the *Lancastrians*, reports kindly remembrance of the American hospitality and extends greetings in anticipation of meeting again in London in 1929. Among those present are James M. Primrose, Falkirk, Scotland; Paul Ropsy, Merxem-les-Anvers, Belgium; E. V. Ronceray, Choisy-le-Roi, France; Leon P. Mountupet, Paris, France; Claude Primet, Paris; Paul Thome, Ardennes, France; Carlo Vanzetti, Milan, Italy; H. Magdalenat, Bourges, France; Antonio Galtrarossa, Verona, Italy; Luigi Gualco, Torino, Italy; H. Coqueugnot, and R. Henry, Luxemburg; Mr. and Mrs. Frank Russell, Worksop, England.

Warner R. Thompson Co. has moved its offices from 604 Kerr building, to suite 407 Curtis building, West Grand boulevard at Hamilton, Detroit.

## Announce Plans for European Trip

Members of the American Foundrymen's association have been advised through an official communication from President S. T. Johnston of plans for the European tours to be held in connection with the Third International Foundrymen's Congress, June 9-13, in London. These plans which were announced previously in THE FOUNDRY have been changed in a few details. The first party will leave New York on the S. S. CARMANIA, Friday, May 10, going through the channel and directly to London before landing. The main points of the tour as previously announced have been maintained. The preconvention tour as announced includes excursions in and about London, to the Shakespeare country, and to the important industrial centers of Birmingham, Manchester and Glasgow. The return trip will be by way of Edinburgh, Newcastle and Sheffield to London where the international exhibition and convention will be held.

Arrangements have been made whereby those who desire to do so may leave on May 15 on the BERENGARIA, arriving in London one day after the party which sails on the CARMANIA.

The return will be made either by the LANCASTRIA or the BERENGARIA, both sailing on Saturday, June 15. The former is due in New York on Monday, June 24, and the latter on Friday, June 21.

The announced fare for the main tour including accommodations on the slower steamship is $652. This includes the steamship fare and accommodations, the rail and motor coach fares during the preconvention tour and hotel accommodations.

The price for the main tour including first class steamship accommodations on the BERENGARIA both ways with the same tour provisions is $894.

A briefer trip, leaving New York May 31, arriving in London the day before the convention and returning the day after, is quoted at $391 for the cabin steamship accommodations and $658 for the first class steamship sailings.

The itineraries were arranged by the American Foundrymen's association committee on international relations, working with Thomas Cook & Son.

Union Mfg. Co., New Britain, Conn., has appointed E. M. Hanson & Co., 130 North Fourth street, Philadelphia, its sole distributor in Philadelphia territory.

*Discusses Correction of*

# Unsafe Foundry Practices

By Nelson H. Kyser

SEVERAL hundred years ago, the idea was conceived that castings could be made from molten metal. At that time the process was crude, and development until now has been almost phenomenal, as the modern methods and devices for handling molten metal have been improving each year. Even in the light of this remarkable progress, the author is firmly convinced that there is much room for further improvement.

In years past, industry was conducted on what might be termed a *miniature basis*. Our huge manufacturing monuments of today were mere blacksmith shops of one or two rooms. The foundry proudly boasted of a cupola of one ton capacity per day and the personnel consisted of a handful of men who were closely associated with their employer. Every one of these men was working with, rather than for, his superior. The amount of molten metal handled was small and the hazard negligible. Today, with foundries having capacities of hundreds of tons per day and employing thousands of men, foundrymen are faced with the problem of correcting those practices which are unsafe. The ultimate which is being striven for is to obtain that same spirit, that same working together, which existed in years past in the small shop.

Several years ago the corporation, which the author represents, constructed a modern foundry which occupies 13½ acres of floor space and at normal times employs about 1300 men and women. When the Studebaker Corp. inaugurated its safety organization, it had trouble in getting employes educated to working safely and to protecting themselves. However, this company has made a wonderful showing, due to the fact that everyone from the production manager on down to the floor sweeper is vitally interested.

This, is the keynote to foundry safety. Foundrymen must educate every soul connected with foundry work to think, act and live safely. The individual who does not think of his own personal safety or of injury to others which might result from his negligence is criminal in intent and is the worst hazard a foundry can have. Quite often such a man exists simply because he has never been educated to safe practices.

The foundry superintendent, the foremen, the gang bosses, all hold their positions because they have a superior knowledge of foundry work and, because they are executives in some degree. It is with these men that the safety school must start. These men must get the safety habit and believe in it. They, in turn, must pass it on to their men and, in the case of a wayward one, give him a little personal contact to show how much better off he and his fellow workers will be if they are working safely. Men should be picked for the particular job for which they are most fitted and, in case of an unsafe move, should be shown where they are at fault. However, a man who is continually working unsafely is a hazard to himself and his fellow workers and should be discharged for his disobedience and unsafe practice.

Actual education of the men will vary according to the specific problems of each individual foundry, but there are a few fundamentals that will apply to foundries in general.

Every man must be taught to be a good housekeeper, as a clean, orderly shop means careful workmen and greatly reflects on the quality of the product. If aisles and passageways are blocked or are strewn with foreign matter the possibility of spilling a ladle filled with molten metal is increased greatly. If flasks are piled so that they may topple over, the hazard of crushing or badly lacerating a fellow workman is present. Many other instances might be cited where a poor housekeeper was the cause of an accident, but this is really a problem for each individual foundry to work out. If each foundry superintendent would call his foremen together and outline a program of getting clean and keeping clean, good housekeeping would no longer be a task and would become a habit and the unsafe practice of poor housekeeping would no longer exist.

There is always a safe way and a dangerous way to do a job. We may show a man the safe way to do the job by calling his attention to the danger of the different operations, but it would be folly to set forth a hard and fast set of rules for him to follow. In the author's judgment, it would be better to allow the man himself to develop the safest method of doing the job without injury to himself because of the vast difference in human element. It would be ridiculous to expect men of different status and temperament to work with identical movements. The employe should be cautioned against using a rusty skimmer or rod when skimming or stirring molten iron and should be told of the danger which results from these practices. Pouring molten metal into moist ladles should be avoided, as should watching the metal rise in the mold without the necessary goggles. There are many other things in this connection which are dangerous and where the new man is likely to encounter sorrow. Here again is where the executive in charge functions as a teacher.

Proper clothing must be given its share of consideration in the correction of unsafe practices in foundries. The Studebaker Corp. insists that all men engaged in handling and pouring molten metal in its foundry must have good, solid shoes without the slightest defect; either asbestos trousers or slow combustion leggings; wool shirts preferably and regula-

## Speaks on Safety

*THIS article was abstracted from a paper presented by Nelson H. Kyser, safety engineer, Studebaker Corp. of America, South Bend, Ind., at the seventeenth annual convention of the National Safety council held in New York, Oct. 1-5. The address was given at the meeting of the metals section at the Waldorf-Astoria hotel.*

tion safety goggles. Without these articles they are not given any metal from the pouroff man who has charge of the large distributing ladle. This rule is enforced 100 per cent and the results are gratifying, as a man seldom is denied metal due to his being unsafely clothed.

The time to teach the employe that burns and injuries caused from unsafe clothing result in intense pain; loss of time and money, both to himself and employer; and often permanent injury, is before he has to undergo these tortures. It is much easier to enforce rules relative to proper clothing if each workman realizes that he is not being made to wear certain articles because it is so much red tape, but as a safeguard to himself. The safety department has attempted to teach safety with kind words, and this always is our first method of attack, but, in some instances, it is necessary to resort to what is called *hard boiled* procedure, as it is human for some individuals to disobey rules which have been inaugurated for their own welfare, and in rare cases have resorted to immediate discharge of an old offender.

Thus far the author has dealt only with personal education as a means of correction of unsafe foundry practice. Attention to the hazards which are due directly to the foundry layout must be considered. The more mechanical devices there are installed the less will be the possibility of accidents. In the foundry of the Studebaker Corp., it has attempted to do as much work by mechanical means as seems practical. Although it is not as yet 100 per cent, this company hopes in the near future to install mechanical means of doing certain jobs that further remove the employes from the danger zone.

In starting with the raw pig and following it through until the castings are ready for machining, many opportunities for the use of mechanical devices may be observed. The opportunity first presents itself in handling raw stock. Magnetic cranes can be brought into use for the pig and scrap, while hopper bottom bins make a safer and easier way to handle the non-metallics. All the ingredients of the charge may be loaded into small cars, weighed and transferred to the charging floor untouched by the human hand. This practice will eliminate crushing injuries and also the possibility of hernia, which is caused frequently by the strain of overlifting.

After the charge is on the charging floor, it should be dumped mechanically into the cupola. This method will avoid hand shoveling the charge, where a man may slip and fall into the mouth of that raging hell. Serious thought should be given also to proper ventilation, as the gases on the charging floor are extremely piosonous. In cases where the ventilation is poor or the ventilating system temporarily is inoperative, the workman should be furnished with suitable respirators.

In the pouring of molten metal one of the most important applications of mechanical means, and also one that is used the least, must be given consideration. When a full ladle of molten metal must travel hundreds of feet over the heads of a great many workmen, dropping and slopping of the molten metal may result in serious burns. If, instead of this dangerous practice of transferring the molten metal a great distance, the conveyor system for carrying the molds is installed, one of the greatest foundry problems is solved. The molds can be placed on conveyors and transferred to a point 25, or not over 50, feet from the cupola and poured. This would bring but relatively few men into the danger zone.

The installation of a conveyor system of this type would require a sizable expenditure, which at the outset might appear somewhat unreasonable, but when the benefits derived from its installation are enumerated the foundryman can easily see where it would correct one of the most unsafe foundry practices. The peace of mind of all concerned would be without price; the inspection of long monorail systems would be eliminated; the danger of slop over would be cut to a minimum; and the use of hand ladles, with their many evils, would be history.

After the molds are poured they continue on the conveyor to the shakeout, where extreme care must be exercised whether done mechanically or by hand.

The shipping and grinding department should be in a separate room from the rest of the foundry. This room should be well lighted and ventilated. All workmen should wear goggles and hard toed shoes to avoid eye and foot injuries. The various tools should be frequently inspected for their suitability and condition. The use of chisels with mushroom tops is dangerous and should always be avoided. The chipping room should be large enough to allow considerable distance between each chipper, as flying chips often are responsible for serious injuries.

A summary of the high spots in the correction of unsafe practice in foundries follows. First, the safety engineer only can be the watch dog and must have the co-operation of every foundry employe. To obtain this co-operation every man must be educated in the school of safety to be a good housekeeper, a safe worker, to dress properly and, where the occasion demands, wear his goggles or respirator. Secondly, the management itself must give serious thought to the safest layout possible that it may make use of all possible mechanical means, thereby removing the employe from unnecessary and avoidable dangers.

## Designs New Furnace

The University of Illinois engineering experiment station recently has issued a circular describing a laboratory furnace for testing the resistance of firebrick to slag erosion. This furnace has a cylindrical furnace chamber supported vertically on rollers which is rotated about its axis during the test. It is heated to any desired temperature with controlled atmospheric conditions by a blast burner using city gas and air, both at high pressure. Powdered slag is fed at a uniform rate through the burner and impinges with the blast on the vertical faces of the standard-size, test brick which form the chamber lining. The melted slag flows down over the faces of the brick and out through a port in the middle of the furnace bottom. By rotating the furnace, each test brick is brought into position before the burner. Identical conditions and uniform slag treatment of the brick thus are insured. A close control of both temperature and furnace conditions may be maintained to simulate the desired conditions.

The bulletin gives the detailed construction of the furnace and the methods used in making the tests. It also gives the results obtained on firebrick tested under conditions similar to those in boiler settings. The advantages of this type of furnace also are given. The circular is well illustrated with photographs and sketches of the furnace. Curves and tables give the results of the tests. These tests were carried out with the cooperation of the utilities research committee made up of representatives of public utilities and the special research committee on boiler furnace refractories of the American Society of Mechanical Engineers.

This bulletin issued as circular No. 17 may be obtained for 15 cents by addressing, University of Illinois engineering experiment station, Urbana, Ill.

# Melting Iron in the Cupola

*By J.E.Hurst*

## Part VI

PIG iron and scrap portions of the charge are never desirable in large individual sizes, although, of course, this always cannot be avoided. The pig iron preferably should be used in quarter pigs, and the scrap in small convenient sizes.

The amount of limestone necessary will depend largely on the ash content of the coke and the relative cleanliness of the scrap. Excess limestone should be avoided as it invariably tends to corrode the lining. Amount of limestone varies from 6 to 10 pounds per 100 pounds of coke charged. The limestone is broken to about the size of ordinary road chippings. Other fluxes such as fluorspar and alkali salts are used for special purposes. These are discussed more fully in a later article of this series.

In selecting the most suitable coke the following points should be noted. Sulphur content, ash content, moisture content, mechanical strength, average size. The sulphur content should not exceed 1 per cent and the moisture 2 per cent. The amount of ash decreases the heat value per unit weight of coke and increases the quantity of limestone necessary for fluxing purposes. Coke should be sufficiently strong to resist handling, charging and the burden of the charges.

General practice leaves the tap hole open after the blast has been put on and allows the molten metal to trickle through until it appears hot and fluid. The tap hole then is stopped by a clay bot, carried on the flattened upset end of a round steel bar, called the botting stick.

A sharp pointed steel rod is used to tap out the metal. Care should be taken to stop the tap hole immediately when signs of slag make their appearance. Tapping becomes extremely difficult when a quantity of slag is allowed to get into the tap hole. The tuyers should be kept clean and free from chilled slag which tends to accumulate and overhang them in the front and immediately above. This is done by poking with an iron bar. Care always should be taken to prevent slag and metal overflowing through the tuyeres into the windbelts. Considerations of pressure and volume of blast are of vital importance in successful melting and are dealt with fully in a subsequent chapter.

### Use Good Materials

*SATISFACTORY melting conditions depend on suitable material, fully as much as they do on methods and equipment. Coke should measure up to certain specifications in physical and chemical properties and limestone should be employed freely, to flush the furnace and keep it clean. Many pieces of mechanical equipment have been developed for handling the slag, for breaking pig iron and for weighing the charges. On account of the severe service and the heavy loads, cupola and foundations should be strong and substantial.*

Melting is continued, and as the charges sink in the stack, they are renewed constantly by fresh material according to the demands of the foundry. Should the demand cease temporarily, melting may be stopped or slowed by reducing the quantity of blast. If for any reason this temporary stoppage is likely to be extended, the metal lying in the hearth of the cupola should be tapped out. If it is allowed to stay in the hearth too long it will freeze in the tap hole and cause delay and trouble when melting is resumed.

Some operators prefer to keep the slag hole open throughout the entire heat while others prefer to open it at regular intervals. In long daily melts, it certainly is safer to keep the slag hole open and thus obviate the necessity for constant watchfulness on the part of the attendant to prevent the over accumulation of slag. With continued melting, the quantity of slag increases and this can be removed only by keeping the metal in the hearth sufficiently high to float it off through the slag notch.

When the melting is completed, the tap hole is left open and all the slag and remaining liquid iron in the bottom of the cupola is allowed to drain off. The locking device or the prop and wedge under the bottom doors then is removed, allowing the bottom doors to remain open. When a prop is used, a link generally is attached to the bottom of the prop into which the hook of a chain can be inserted to pull it away in safety.

If the bottom has been well made, there should be plenty of time to remove the locking device safely, and no sudden dropping or splashing of the material need be anticipated. Upper layers of the sand bottom generally are fused together into a viscous, glassy mass and usually some seconds elapse before the weight of the material remaining in the cupola penetrates this. A few trickles of slag and metal are followed by the sagging of the fused bottom which ultimately breaks and allows the material to fall through.

In common practice the dump falls on a cast-iron or steel tray which readily can be pulled from under the cupola by the crane. The chain or cable passes through a snatch block

anchored in the floor for the purpose. Special dump cars, mounted on bogie wheels are employed in some places. Dumped material remaining under the cupola is quenched with water, particularly around the supporting columns and any large lumps of material adhering to the sides of the cupola are removed by a long bar. After this dumped material has cooled, it is removed from underneath the cupola. Unburnt coke and metal are sorted out and returned to the stock piles.

### Scaffolding Causes Trouble

Scaffolding probably is the most serious trouble likely to be encountered in normal melting practice. Through various reasons the charges above the tuyeres may be prevented from descending by the formation of a more or less solid arch of partially solidified slag and metal. The coke in the bed burns away from underneath thus leaving all the charges suspended in the cupola shaft. This is a serious state of affairs, for if the metal cannot be melted out, it is a laborious task to remove it by any other means.

The principal cause of scaffolding is the formation of lumps of hard solidified slag immediately above the tuyers which prevent the uniform settling of the charge. Other causes are: (a) projections remaining on the side of the cupola, resulting from bad fettling; (b) falling in of the daubing material; (c) pieces of metal of too large a size; (d) choked tuyeres which interfere with the blast supply; (e) dirty scrap and insufficient flux.

If the bed coke has not burned away too much, a scaffold generally can be removed by introducing coal into the furnace through the tuyeres. Sufficient coal, easy ignition and long flame, generally will cure the most obstinate scaffold. Scaffolding, particularly that due to the formation of lumps over a tuyere or a piece of metal getting in front of a tuyere usually can be cured if caught in time by closing the offending tuyere for a short period. This treatment generally melts out the obstruction.

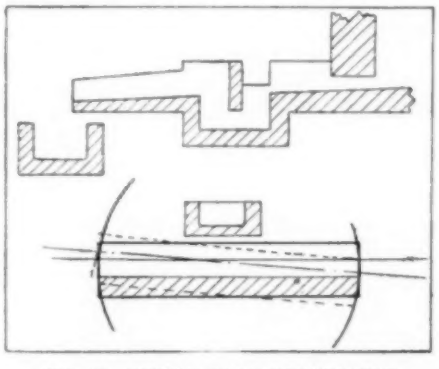


FIG. 35—SIMPLE SLAG SEPARATING DEVICE

Many cupola attendants do not know the cupola may be banked for a fairly prolonged period and restarted without the necessity for dropping the bottom. This practice is fairly common, particularly in continuous plants where the cupola is shut down for the noon hour. To do this effectively, the cupola should be provided with a tap hole breast and plate. The entire charges preferably should be melted down and tapped out of the cupola, although this is by no means necessary if the tuyeres are provided with dampers which can be closed effectively. The liquid metal remaining in the cupola well should be tapped out. In anticipation of a long shut down the tap hole breast should be removed and the slag allowed to drain out. The breast then can be closed temporarily by a metal plate and the tuyeres closed by the dampers to prevent the natural draft of the cupola from melting the remaining charges. When ready to make a new start, the breast can be built up again, and the tap hole remade in the usual manner. The tap hole is re-dried almost immediately after the blast is re-started and melting can be continued. It is advisable to increase the coke charges slightly for the first few charges, to make good any extra losses incurred during the banking up period.

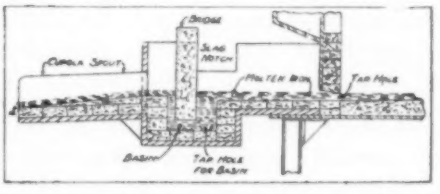



FIG. 36—SECTIONAL VIEW OF SLAGGING SPOUT

Several special purpose devices resorted to in special cupola practice are dealt with in this chapter. The most common are the slag separating devices. Probably the earliest form of slag separating spout was that shown in Fig. 35 and used in agricultural machinery foundries where the cupola stream ran continuously all day.

When molten metal flows into the basin the slag on top of the metal is held back by the bridge and flows off through the slag notch on the side of the spout. While the furnace is in operation, the top of the slag chamber is covered with a flat, fire-brick tile. It is practically impossible for the slag, resting as it does on top of the metal, to pass the bridge, into the mixing ladle. At the close of the heat, the metal in the basin is tapped through a hole in the side and drained off.

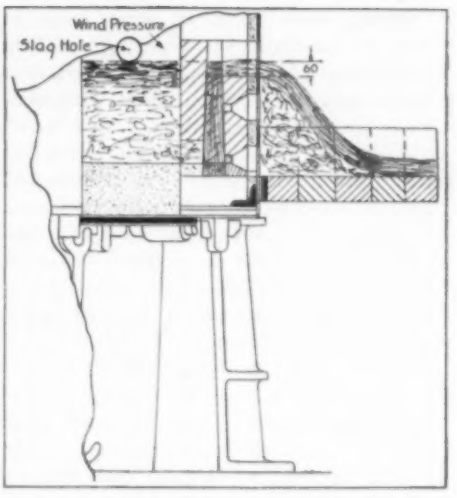



FIG. 37—ARRANGEMENT OF SYPHON BRICK

Continuous operation with this type of spout is facilitated by a tilting extension shown diagrammatically in Fig. 36. A refractory lined spout is mounted pivotally at right angles to the main spout. This arrangement can be used continuously for filling ladles brought into position on either side of the tilting extension and thus prevent the splashing and waste which inevitably occurs with a continuous metal stream while changing the ladles.

A more modern slag separating device has been developed by E. V. Ronceray and forms the basis of several devices now in use for removing slag from the metal stream. Action of this device and its construction are shown in the illustration, Fig. 37. The bottom tap hole is used for emptying the cupola and syphon. A syphon brick forms the basis of most of the slag separating devices which have been embodied in the various special receiver designs to be described later.

An interesting mechanical tapping device shown in Fig. 38 has been designed and operated in Germany. The method of operation is clearly evident from the illustration. It is claimed that when this device is handled properly, the tap hole is closed simply by pulling a lever, and is reopened to let the iron out by releasing the same lever. The plug comes out smoothly and the plug and plughole last for weeks without renewal. The cast iron plug has a taper slot at one end for fixing on the lever, and a large pitch thread at the other end for holding the refractory composition which acts as the plug for the tap hole. The best plug composition is supplied by the makers of the apparatus.

Where slag is handled in large

volume, some form of slag ladle is used to facilitate the transport of this material. The simplest is a cast-iron bowl, mounted on trunnions and carried on a bogie frame. The bowl usually is in a truncated, pyramid form, with the wide end uppermost and all corners substantially radiused. Usually the cast iron bowl is unlined except with a coating of claywash or blackwash. Cold slag readily is dumped from this type of ladle. In some places a substantial steel eyebolt, with a long shank is imbedded in the slag as collected. By this means, the mass of cold slag can be handled by a crane. Ladle bowls, trunnions, bogies and frames of slag ladles, invariably receive rough handling. For this reason any endeavor to save weight of material in their construction is false economy.

Pig breaking machines occupy a place in the list of auxiliary cupola plant. Pig breakers operate by direct belt or electric motor drive, or from the hydraulic power service. The electrically driven type readily is adaptable as a portable machine. A simple hydraulic type machine is illustrated in Fig. 39. Pig breaking by machinery in the general foundry is not so common as one might expect. Machine cast pig iron has rendered it practically unnecessary. It is alleged generally that the act of lifting the individual pigs to the table of the breaking machine, is practically as arduous a task as breaking by sledge hammer. In the adoption of machine breaking, the design of the machine and its location in respect to the stock yard, the stock yard handling mechanism and the cupola charging arrangements require careful study.

Weighing equipment is by far the most important item in the list of auxiliary cupola plant. Construction of weighing machines is in the hands of firms specializing in this class of machinery, and the foundryman today has available an almost unlimited choice of simple and automatic weighing machines, platform, beam, suspended type, direct reading and automatic. It is hardly necessary to deal with this feature in detail.

### Weighing Machines Needed

Beyond dispute, accurate weighing of the components of the cupola charge, is fundamental in obtaining uniform quality of molten metal. Likewise beyond dispute, weighing of the coke charges is the only method of exercising strict control over cupola economy. In view of the importance attached by every foundryman to fuel economy in the cupola, it is surprising to find the large number of plants still remaining where the coke charges are not weighed. Weighing the coke charges results in greater fuel economy than is secured by many of the fanciful devices proposed for this purpose.

Character of the cupola plant necessitates a good solid foundation which usually takes the form of a substantial concrete bed resting on the gravel into which the columns are bolted by substantial long bolts with large washers. Usually the four columns are tied together, either by a cast iron foundation plate or steel angle irons and cross bracing, which in all cases should be covered by a 3-inch layer of good concrete. The cupola shell erected on these columns should be free from all staging to allow perfectly free expansion. Where inclined charging devices are attached to the cupola, it is a good plan to allow some freedom in the attachment for this same purpose. The cupola foundation and the foundation of the inclined charging machine should be carried on a continuous reinforced concrete foundation or raft, and a similar form of reinforced concrete raft foundation is advisable in all cases where the solid character of the earth foundation is suspected.

The cupola shell generally is supplied either painted with red oxide paint, or with one of the bitumen base paints now available. It is a good plan to allow this first coat of paint, also the mill bloom on the steel plates, to disappear by the combined action of heat and atmospheric weathering, before repainting. The shell should be well scaled before repainting, and should be repainted every twelve months.

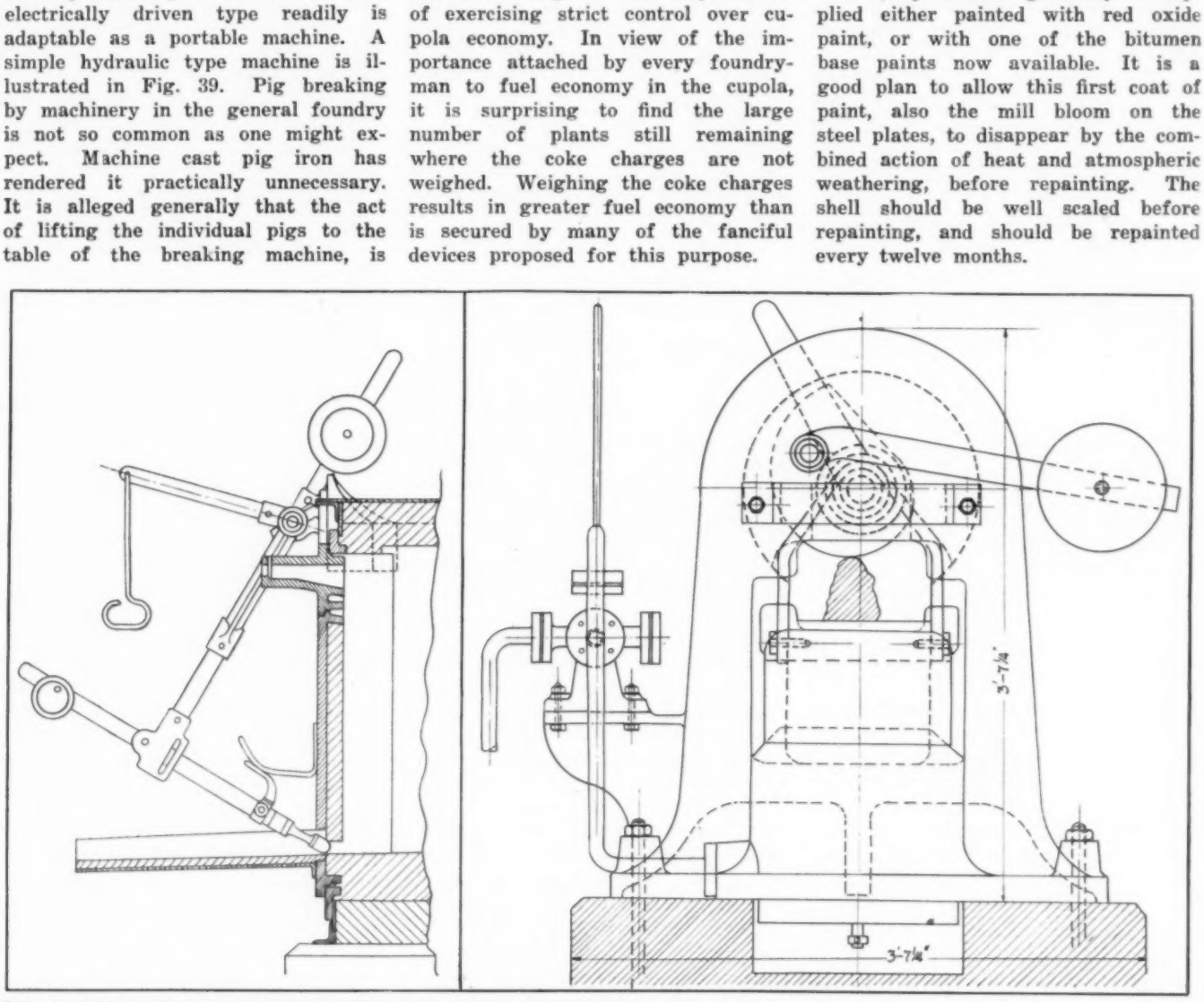



FIG. 38—MECHANICALLY OPERATED LEVER FOR STOPPING THE STREAM IN THE TAP HOLE. FIG. 39—A HYDRAULICALLY OPERATED MACHINE IS UTILIZED IN SOME PLACES FOR BREAKING PIG IRON

# Charles Vickers Says—

## *Tests Show Value of Deoxidizing Agents*

**This Is Number Four of a Series of Articles on Practical Brass Founding**

WHILE aluminum is one of the most powerful deoxidizing elements known, its effect on copper when used merely as a deoxidizer, is not as satisfactory as might be desired, and as a result, it has not found any extended use in that particular field. In some respects it has the same action as silicon on copper. It produces a similar film over molten copper surfaces, which breaks up, drains and leaves husks of drossed metal which are flattened by the pressure and accumulate in certain parts of the casting as laminations. This difficulty can be avoided largely by easing the metal into the mold in such a manner that the film is broken as little as possible. This method naturally will limit the accumulation of husks as the metal flows into the mold. All copper-base, nonferrous metals containing aluminum, even in a small quantity, will behave in a manner quite similar to the aluminum bronzes, and therefore, require much the same treatment in making them into castings.

Precautions to be taken to secure clean, sound sand castings of aluminum bronze clearly were outlined by Prof. H. C. H. Carpenter and C. A. Edwards in a paper dealing with the production of pressure resisting bronze castings presented at the meeting of the Institution of Mechanical Engineers, London, Eng., and published in THE FOUNDRY, February 1911, pages 255-261. These are: (1) The metal should be poured slowly. (2) The gate should be arranged so that the metal enters the mold at the lowest possible point. Broadly speaking, any form of gate will do, but the authors' conclusion is that it is decidedly advantageous to provide a sort of well at the bottom and use a rather narrow opening, to admit the metal to the mold. (3) In the case of green sand molds, wet sand must be guarded against particularly where the metal rests on the sand. If a rather close sand is used it is far safer to dry the surface of the lower part of the mold before it is poured.

Further, under these conditions the metal enters the mold quietly. As it spreads the skin of alumina is stretched, and broken, and fresh alumina is formed until, the full length of the casting is filled. As the metal rises the skin is not broken, but is pushed up until it reaches the upper surface of the mold. After this the metal mounts the riser, pushing the skin until the riser is filled. The final result is a casting with a thin and approximately uniform skin of alumina containing perfectly clean metal inside. The proper pouring temperature for a 10 per cent aluminum bronze is given by these investigators as 1125 degrees Cent. (2057 degrees Fahr.).

### Better Surface Appearance

The addition of a small amount of aluminum to copper, sufficient to deoxidize, makes no appreciable difference in the color of the red metal. Unfortunately for the surface appearance of such castings, the film or skin is so extremely thin that it breaks or rents instead of stretching and the newly exposed metal at the rents re-oxidizes to a silvery sheen giving the casting streaks of a fish-like appearance. This spoils the beauty of the castings, and has a bad effect on their saleability. They are also likely to be unsound when machined, and in addition, the electrical conductivity is comparatively low. An addition of 0.10 per cent aluminum to copper lowers the conductivity some 27 per cent. Aluminum thus appears to be less harmful to the conductivity of copper than silicon as 0.10 per cent of the latter reduces the conductivity to 57 per cent as against 73 per cent for that amount of aluminum.

Surface appearance of aluminum-treated copper castings is greatly improved by prealloying the aluminum with some other element, for example, vanadium. When 0.25 per cent of alumina-vanadium containing approximately 16 per cent vanadium was used to deoxidze copper, the sand made castings had a good commercial appearance, and when machined the copper proved to be perfectly sound. Electrical conductivity was determined on a cast specimen in the form of a round bar, which when machined was ¾-inch diameter and 24 inches long. Conductivity as determined was 61 per cent, and may be compared with the similarly cast bar of copper deoxidized with the alloy of silico-calcium copper, mentioned in a former article and which had 73 per cent conductivity. No doubt 0.25 per cent alumino-vanadium is a much larger quantity than is necessary to produce sound castings, as the alloy was not diluted with copper, but was pure vanadium alloyed aluminum. The amount of aluminum added to 100 pounds of copper was 0.21 per cent, and of vanadium 0.04 per cent which gave 61 per cent conductivity in sand castings.

In the silico-calcium deoxidized copper the deoxidizer added consisted of 7.5 per cent silicon; 2.5 per cent calcium, and 90 per cent copper, so when 2.25 per cent of the alloy was used only 0.01875 per cent silicon and 0.00625 per cent calcium were added. With this minute addition only 73 per cent conductivity was realized. It should be understood that in commercial practice it has been found that from two to four times this amount of this alloy has to be added to insure sound castings, or from 8 to 16 ounces of the alloy, with an average of 12 ounces. Actual tests with castings and on drawn wire showed that with the wire increase of 15 per cent conductivity reasonably could be expected. When 12 ounces of the silco-calcium copper deoxidizer was added, sound castings of copper could be consistently obtained in commercial practice.

Conductivity of this metal when drawn into wire would be over 70 and under 80 per cent, which as already stated, while eminently satisfactory a few years ago, now has been surpassed, necessitating such improvements in this alloy as to bring

its results into the 80-90 per cent range. The point that the author wishes to make in drawing this comparison between silicon and aluminum as deoxidizers for high conductivity copper castings is that while neither of the two elements possess any great value as deoxidizers when used alone, that both of them are worthy of consideration when alloyed with other elements. Aluminum has some slight advantage to start with which might be improved by proper alloying, designed to slag off residual aluminum, so that the aluminum alloy would make a highly efficient, low cost copper deoxidizer.

As a matter of interest the influence of small additions of aluminum on the physical properties of copper are shown in Table I.

Test bars used were cast to size in sand molds. It will be noted that the tensile strength and elongation increase with increase of aluminum. Further additions of aluminum as is well known increase the tensile at the expense of the elongation, until with 10 per cent aluminum and 1 per cent iron, a tensile strength 70,000 pounds per square inch with 25 per cent elongation is reached. However, such alloys cannot, by any stretch of the imagination be called copper.

Table I

## Effect of Aluminum on Copper

| Deoxidizer | Per cent added | Yield Point lb. per sq. in. | Ultimate Strength lb. per. sq. in. | Elongation Per cent in 2 in. | Reduction of area Per Cent |
|---|---|---|---|---|---|
| Aluminum | 0.10 | 6700 | 26,400 | 38.5 | 63.5 |
| Aluminum | 0.10 | 6200 | 26,800 | 44.5 | 57.4 |
| Aluminum | 1.00 | 5600 | 29,600 | 41.5 | 67.6 |
| Aluminum | 2.00 | 7800 | 31,400 | 34.0 | 53.0 |
| Aluminum | 3.00 | 7100 | 28,400 | 34.0 | 50.5 |
| Aluminum | 3.00 | 7000 | 32,300 | 54.5 | 76.6 |
| Aluminum | 4.00 | 8200 | 34,200 | 49.0 | 61.5 |
| Aluminum | 4.00 | 8200 | 33,800 | 51.5 | 53.8 |

Table II, shows the influence of other elements than aluminum upon the physical properties, as determined from sand cast bars of standard size and shape. It will be noted that when the copper is deoxidized properly its physical properties approach closely those obtained with aluminum.

The boron copper was the commercial alloy sold under that name. Carbon was interesting because it was an attempt to deoxidize copper with carbon alone. The copper was melted in a crucible in the bottom of which a bar of graphitic carbon was wedged securely before the copper was charged. This bar remained in place during the time of melting, and as the copper reached the molten stage and became hot, fine bubbles were evolved from the carbon bar. These bubbles rose through the bath of copper, in a manner similar to that exhibited when a bottle of seltzer water is opened.

This was thought to be an encouraging feature. The gas evolved was considered to be carbon monoxide, (which no doubt it was) and it was hoped this gas would combine with the oxygen in the copper reducing the cuprous oxide, and then vanishing as carbon dioxide. However, it did not work this way, with the result that the copper casting obtained in sand molds, while apparently they set soundly, and failed to bulge in the heads, were finely porous when machined.

Bars marked carbon in Table II, were not sound, but they were better than those obtained when boron copper was used as a deoxidizer and the results speak for themselves. The falling off in the physical properties as unsoundness increased is worthy of note.

Another powerful deoxidizing agent is magnesium. It has been known for years as a deoxidizer of copper for making sand castings. When first brought to the attention of brass foundrymen it was in the shape of bars 5/8-inch square and 12 inches long, which looked as though they had been sawed off a flat plate of that thickness. Later, while the bars were of the same cross-section it was plain to see they were produced by extrusion. This was a convenient form as the bars could be sheared easily into small pieces to make weights or after being nicked, easily could be broken.

To produce sound copper castings it was suggested that an addition of 2 ounces of magnesium per 100 pounds of copper be made. The magnesium should be plunged to the bottom of the crucible by any suitable means, and there stirred around until dissolved and incorporated. The results attained with this deoxidizer were not uniformily successful, for while the castings when taken from the sand usually were of good appearance, it was very common to find on machining that, they were a mass of blowholes particularly on the cope side of the castings. This condition was so persistent, and as a consequence the production loss so heavy that in many cases the use of magnesium was abandoned. This was the experience of many foundrymen who experimented with magnesium as a deoxidizer of copper for sand castings.

### Carry On Tests

Some 18 or 20 years ago a sustained and expensive (because of the losses) series of tests were carried out by the author with magnesium in copper. At the same time another and independent investigation was being made at the West Allis works, Allis-Chalmers Co., West Allis, Wis., and a comparison of the results obtained showed them to be identical. After a time it was discovered independently by both investigators, that this condition could be corrected by the addition of a small amount of phosphor-copper with the magnesium, and this practice then was followed. The effect of the addition on the conductivity of the copper was not ascertained at the time. The addition of 0.10 per cent magnesium alone, usually gave conductivities that ranged between 80 and 90 per cent, with a preference for the lower values. This method of deoxidizing copper gives satisfactory castings, with a low production loss, and there is no reason to believe it is still largely used.

Some time after the above experiments were made, a sample of cast copper 19 pounds in weight was obtained from a brass foundry noted for making fine copper castings. This sample was melted in an electric furnace of the granular resistance type designed for crucibles which was described in THE FOUNDRY, July, 1917, pages 280-283. It was possible in this furnace to melt copper without oxidation as the chamber when sealed become practically a muffle. The sand castings from the sample were perfectly sound, and a test bar was made like the others described in this article, namely a round bar 1-inch in diameter and 24 inches long, machined to ¾-inch in diameter. The conductivity was determined on this bar, and was found to be only 30 per cent.

Such copper of course has no value for electrical purposes, though it produces a fine cast copper suitable for many other purposes. Analysis showed the deoxidizer that had been used was magnesium and phosphorus together. It may be added that whenever magnesium is used to deoxidize copper, it is better to add it prealloyed with

copper instead of adding metallic magnesium. The 10 per cent alloy of magnesium and copper is convenient for calculations, though the higher alloys may also be preferred, as they are somewhat more easily broken for weighing the small amounts necessary. No particular difficulties are encountered in alloying the magnesium with copper, and it is not necessary to use phosphorizers in adding the magnesium.

### Use Good Materials

Copper should be the best electrolytic obtainable, and it is advisable to melt it in crucibles under a cover of granular charcoal. The magnesium, broken into convenient pieces should be warmed previously and then dropper gently on the charcoal covered copper. It should be pushed under the surface of the molten metal, and the latter stirred in. Then another addition of magnesium is made and stirred in, and so on until the alloy is completed. Magnesium-copper should be cast quickly into ingots, preferably in covered molds which will keep down the amount of dross formed. A 10 per cent magnesium-copper made to contain 90 per cent copper and 10 per cent magnesium, gave on analysis 91.06 per cent copper and 9.02 per cent magnesium. This alloy was poured into open ingot molds and the loss probably ran a little higher than if covered molds were used.

Calcium-copper can be made in the same manner, but instead of using charcoal, a flux of lime on the copper is advisable so that when the metallic calcium is pushed down into the molten copper it will be protected instantly from the furnace gases. When calcium is alloyed with copper, a large amount of heat is liberated and the copper becomes intensely hot. Therefore, it is advisable to hold back some of the copper of the charge with which the alloy can be cooled between additions of calcium. Also the calcium should be permitted to lie for a couple of minutes on the hot charcoal before being pushed into the molten copper. This is done to drive off any moisture present, as it frequently happens some chloride may be present in the calcium, which absorbs moisture and is always damp.

A calcium copper was made in this manner by melting 86 pounds of copper, then adding 14 pounds of calcium to make a 14 per cent calcium copper. The product analysed 12.69 per cent calcium. This alloy was made using *cabbage stalk* calcium, which generally carries inclusions of electrolyte. Many other agents have been used or proposed for deoxidizing copper to obtain sand castings of high electrical conductivity other than the elements we have so far considered. Chief among these might be placed boron suboxide.

This material was invented and patented by Dr. E. Weintraub, April 16, 1912 and is a grayish, powdery substance. At first it was thought to be a suboxide of boron, but according to the investigations of H. H. Kahlenberg, *Chemical Abstracts*, Vol. 19, page 1821, 1925, the substance is not a compound of the formula $B_2O$ as thought by Dr. Weintraub, but a mechanical mixture of boron and the definite compound, boron suboxide, $B_6O$. This lower oxide which was first discovered by Kahlenberg is a brown powder, which is not acted on by hot or cold hydrochloric acid, even when concentrated, by hot or cold sulphuric acid, dilute or concentrated, or by hot or cold potassium hydroxide. In this respect it acts much like pure fused boron.

As explained by Dr. Weintraub, *Transactions*, American Institute of Metals, Vol. 6, 1912, pages 138-147, the result of a happy accident. He was engaged in isolating the element boron to discover whether or not it had any value in connection with incandescent lamps. He noted while depositing boron between water-cooled copper electrodes, that, while the element would deposit and grow on the electrodes, there was no combination with the copper. There appeared to be no affinity between boron and copper, whereas great affinity existed between boron and practically every other element. Therefore, it occurred to him that boron might be the natural deoxidizer for copper. It might remove the oxygen and eliminate itself from the copper leaving it pure, sound, and consequently of high electrical conductivity.

That was the beginning of the reign of boron suboxide which as Kahlenberg has shown is a mixture of boron, a lower, or suboxide and boric acid, magnesia and other diluents which constitute the flux part of the mixture. It is necessary to mix the active substances with a flux, so they will be coated over and thus protect against premature oxidation while being used. Some of the finest appearing copper castings have been made by using this deoxidizer, and their appearance has not been improved in any way by incorporating any other deoxidizer, for the boron after oxidation rises out of the copper and forms a rich, red glossy skin on the surface of the copper.

In a number of cases this deoxidizer proved unsuccessful, and the reason lies in the fact that considerable skill is required to use it properly. One requisite to success is that the copper has to be superheated in the furnace, as set forth clearly by Dr. Weintraub, but many foundrymen are opposed to doing this. Old fashioned ideas are held and the thought persists that when copper is heated strongly, it will be burnt. A high temperature is necessary to bring about the reaction between the copper and the boron, and boronic oxide. Consequently when copper merely is melted the flux will fail to deoxidize it.

**Table II**

## Experiment with Other Deoxidizers

| Deoxidizer | Per cent added | Yield Point lb. per sq. in. | Ultimate Strength lb. per. sq. in. | Elongation Per cent in 2 in. | Reduction of area Per Cent |
|---|---|---|---|---|---|
| Silicon | 0.05 | 6100 | 24,800 | 39.5 | 61.7 |
| Silicon | 0.05 | 6700 | 24,900 | 37.5 | 62.4 |
| Ca-Si Alloy | 0.5 | 7100 | 26,900 | 41.0 | 59.5 |
| Ca-Si Alloy | 0.5 | 6600 | 26,000 | 40.0 | 65.3 |
| Boron copper | 2.0 | 6000 | 14,900 | 14.0 | 12.7 |
| Carbon | | 6100 | 17,800 | 20.0 | 21.8 |
| Carbon | | 6100 | 17,400 | 19.0 | 20.5 |

Other important reasons are the use of impure copper, or casting copper, in place of the purest electrolytic copper. Some foundrymen appear to be unable to understand the difference between a casting copper and virgin electrolytic copper. If the metal is red and otherwise looks like copper, it is copper to them, although they meet with disaster every time they attempt to make anything outside their regular routine.

These foundrymen never can understand why the manganese bronze becomes brittle, when they attempt to make the alloy themselves to get away from buying ingot. High conductivity copper castings are entirely beyond their reach, also all other alloys whose properties are expected to be high above the average. It is all the fault of the copper that is being used. This statement is not made in any spirit of antagonism toward casting copper, for it is a valuable raw material and quite suitable for a large proportion

(*Concluded on Page* 946)

# How and Why in Brass Founding

*By Charles Vickers*

## Spoils Appearance

*We are making small aluminum castings of the composition 90 per cent aluminum, 7 per cent tin, and 3 per cent copper and we pour at 1300 degrees Fahr., which is about as low as we can run the job. The molds are made of a fine grade Albany sand and are perfectly clean from loose dirt or molding sand, and yet we have much trouble due to the appearance of tiny black spots developing on the outside of the castings. We are sending a sample casting to better illustrate the difficulty.*

The inclusions do not appear to be grains of sand, although such a possibility is always worth considering because burned molding sand is black in color, which contrasts strongly with the white color of aluminum. On the other hand aluminum alloys do not wash away the sand of the mold in the way the heavier metals are likely to do. Also the sand grains would not be likely to exist always as separate entities, or as individual grains. They would be bound together more or less, producing characteristic sand holes. These black spots then do not appear to be sand, although they are composed of some inert substance, as they do not give off gas when immersed in water, either plain, or acidulated.

A pouring temperature of 1300 degress is not excessive, and lots of aluminum alloy castings have to be poured hotter than that. It is always advisable to have the pouring temperature low, but the metal has to contain heat enough to make it sufficiently fluid to fill the molds completely. Everything considered, the source of the black specks does not seem to lie in the mold, or the pouring temperature, or even in such substances as nitrides and carbides. Otherwise we would get some reaction when testing the specks. The chances are that the nigger in this woodpile is the flux that was used with the metal.

It has been determined positively that zinc chloride was responsible for such occlusions similar to the ones encountered here. After its reaction on the surface of molten aluminum, it will appear black. If it is stirred into the alloy it will bob up again as little specks of slag, and it is easy to get these into the mold. So this is a reasonable hypothesis to entertain as to the cause of this trouble. To decide the matter, using a clean crucible, make a melt of new metal and do not use any chloride. If these castings come free of the specks and no method of filtering them out of the metal can be decided on when using the chloride, it will be better to skim off the debris. Melt this debris later and clean it with zinc chloride, using the metal so cleaned for castings not so particular.

## Will Nickel Help Alloy?

*We are interested in a formula for nickel bronze, to be used in making hot roll mill bearings, and thought that you might be in a position to furnish us with a few alloys that do not contain a high percentage of nickel.*

About the most abused casting that can be made in a brass foundry is the hot mill bearing for it has to do its duty at a temperature to which no self-respecting bearing of any kind should ever be subjected. Also the only lubrication it gets as a general rule, is simply water. If the poor bearing *falls down* and the mill people can get away with it, it is your fault. It is up to you to make good, and many brass founders do make good. Consequently, the game goes on right merrily. There seems to be a presumption in buying circles that brass founders are not in business to make money like the mill man for example. No! They are tenderhearted folks whose aim in life is to help others make money, so they are simply in business for their health.

Now if the questioner is not one of the rank and file and has a scheme to add to the cost of his mill bearings and not lose money, why just experiment with adding one or two per cent at the most of nickel to the regular alloys, which may be 80-10-10, with phosphorus or not as the case may be.

For there is nothing known for a bearing that has got the old-style alloys beaten far, so we put in the lead. While an addition of 2 per cent nickel to any bronze that has to be strong to the core, *at normal temperatures* is eminently worth while, its effect at elevated temperatures is not known by the writer.

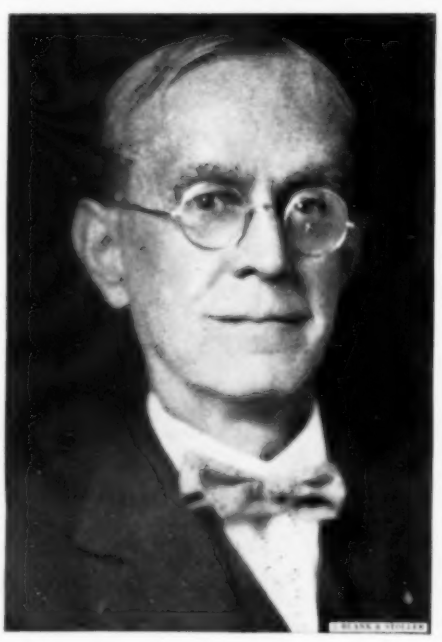
## Explains Loss in Tin

*Can you advise us as to the loss in tin content after melting a mixture of ingot metal containing 90 per cent copper and 10 per cent tin? Also what will be the tin content after melting a mixture of virgin metals to the formula of copper 90 per cent; tin 10 per cent?*

The loss in tin content in the case of both virgin and remelted gun metal will depend upon a number of factors. In the case of virgin or new metals if the copper is melted and oxidized and then the tin is added first, naturally some of it will be lost as it will act as a deoxidizer of the copper. By being converted to the oxide, it either will stay in the bronze as oxide, or rise to the surface.

Tin like most other metals is never absolutely pure. Straights tin may be 99.90 per cent pure, but it is likely to be a little under this, and the cheaper brands will run under this quite considerably, some even go as low as 96 per cent tin. This of course, increases the loss of tin, and has to be taken into consideration. Usually, however, when the best grades of tin are used to the formula copper 90 per cent, tin 10 per cent, the tin loss would be amply covered by an excess of 0.25 per cent of tin, making the copper 90 per cent; tin 10 per cent plus 0.25 per cent for loss. This makes the alloy more expensive and should be covered at the time prices are made. The government practice in remelting the 90-10 alloy has been to add 0.5 per cent more tin in some cases. Tin is not liable to the same losses as zinc; and analyses of alloys made to such formulas as 90-10 and 88-10-2 are just as likely to show tin in excess of 10 per cent as not, both in the case of new metals, and the remelt. Additions of excess tin to compensate for loss are not usually made for tin is expensive. We believe an allowance of 0.10 per cent on the virgin melt and nothing on the remelt will give alloys within the specifications, provided the copper is melted in crucibles and that 2 ounces of phosphor copper are placed in the bottom of the crucible on starting to charge with copper. It will be necessary to add either phosphorus or manganese to insure sound castings.

# The FOUNDRY Family Photograph Album



**Upper Left**

G. M. HOWSMAN

Estate Stove Co., Hamilton, O.

**Lower Left**

G. F. ROYER

Royer Foundry & Machine Co., Wilkes-Barre, Pa.

**Upper Right**

D. J. GLUNTZ

Gluntz Foundry Co., Cleveland

**Lower Right**

E. A. BLASDELL

Reliance Steel Castings Co., Pittsburgh

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

## A LEXICON OF TECHNICAL TERMS

*(Concluded from Data Sheet No. 740)*

### *Ferrite*

Ferrite is considered as the pure iron constituent (alpha iron) or that part of the iron or steel containing practically no carbon in solid solution. When it contains other elements in solid solution it is better designated respectively as phospho-ferrite, nickel-ferrite, alumino-ferrite, manganoferrite, silico-ferrite, chrome-ferrite, vanado-ferrite, etc. Fig. 5 shows the structure of pure ferrite.

### *Graphite*

Thin plates or flakes of pure carbon occurring in high carbon steels, and cast irons. It is an important constituent of gray cast iron. The large black areas in Figs. 14 and 15 are graphite.

### *Temper Carbon*

A form of carbon found in heat treated white cast iron (malleable iron) is called temper carbon. It occurs as rather irregular rounded masses scattered throughout the mass in no particular regular order. It has been considered an amorphous form of carbon but late investigators hold it to be of crystalline form, and the same as graphite. Fig. 15 shows the arrangement of temper carbon and graphite.

### *Miscellaneous Microconstituents*

Intermetallic compounds are quite important as they exist in varying quantities in all the alloys of the iron carbon series. They are responsible for many of the undesirable properties and because they cannot be entirely eliminated their effect on the properties must be considered. These include manganese sulphide, MnS; iron sulphide, FeS; iron oxide, FeO, $Fe_2O_3$, $Fe_3O_4$; iron phosphide, $Fe_3P$, $Fe_2P$; iron silicide, FeSi, $Fe_2Si$; manganese carbide, $Mn_3C$; iron manganese carbide, $(FeMn)_3C$; chromium carbide, $Cr_3C_2$, $Cr_7C$; and flavite or iron nitride, $Fe_4N$.

Intermetallic compounds are shown in the etched specimen of brass in Fig. 16.

### *Etching*

Etching is a term used in connection with the microscopic study of substances. When specimens are polished carefully and observed through the microscope, the outlines between the different constituents and the voids are usually the only things to be seen. If this specimen is put in some sort of a solvent for a short time it is said to be etched. This etching brings out the grain boundaries of the various constituents more distinctly and dissolves different constituents at different rates giving characteristic light effects when observed through the microscope. A large part of microscopic study is dependent on the etching process. There are many etching reagents and many ways of etching.



## NONFERROUS METAL SPECIFICATIONS

### WHITE BEARING METALS

Limits for the chemical compositions specified for metal in ingot form are closer than the limits specified for cast products, as allowances have been made for variations in the chemical content due to casting.

*Specification No. 10, Babbitt*

| | Cast Products Per Cent | Ingots Per Cent |
|---|---|---|
| Tin, min. | 90 | 90.75 |
| Copper | 4 to 5 | 4.25 to 4.75 |
| Antimony | 4 to 5 | 4.25 to 4.75 |
| Lead, max. | 0.35 | 0.35 |
| Iron, max. | 0.08 | 0.08 |
| Arsenic, max. | 0.10 | 0.10 |
| Bismuth, max. | 0.08 | 0.08 |
| Zinc and Aluminum | None | None |

When finished bronze-backed bearings are purchased, a maximum of 0.6 per cent lead is permissible in scraped samples provided a lead-tin solder has been used in bonding the bronze and the babbitt.

*General Information:* This babbitt is fluid and may be used for bronze-backed bearings, particularly for thin linings such as are used in aircraft engines. It is also suitable for die castings.

*Specification No. 11, Babbitt*

| | Cast Products Per Cent | Ingots Per Cent |
|---|---|---|
| Tin, min. | 86.00 | 87.25 |
| Copper | 5.00 to 6.50 | 5.50 to 6.00 |
| Antimony | 6.00 to 7.50 | 6.50 to 7.00 |
| Lead, max. | 0.35 | 0.35 |
| Iron, max. | 0.08 | 0.08 |
| Arsenic, max. | 0.10 | 0.10 |
| Bismuth, max. | 0.08 | 0.08 |
| Zinc and Aluminum | None | None |

When finished bronze-backed bearings are purchased, a maximum of 0.6 per cent lead is permissible in scraped samples provided a lead-tin solder has been used in bonding the bronze and the babbitt.

*General Information:* This is a rather hard babbitt which may be used for lining connecting-rod and shaft bearings which are subjected to heavy pressures; its *wiping* tendency is slight. It is also suitable for die castings.

Abstracted from the Society of Automotive Engineers *Handbook*.

*(Continued on Data Sheet No. 743)*

# Foundries Must Train Workers

## English Foundryman Believes That More Attention Must Be Paid to Apprentice Training If Shops Making Iron Castings in Sand Are To Compete with Other Methods of Fabricating

### By W. J. Hiscox

ALTHOUGH at least one large employer of labor in the United States believes that sand molded iron casting soon will be a thing of the past, due to the rapid development of forgings, stampings and products made by other methods of fabrication, this view is not shared widely, judging by the optimism which prevails in most American and British iron foundries. This optimism is shown by the many installations of modern foundry equipment which continually are being made, and by the development of organizations, to provide more efficient manufacturing methods. No doubt the feeling exists in the minds of those responsible for these developments that a still greater volume of business will be secured by the foundry in the near future.

A few years ago the foundry industry, both in the United States and in Great Britain, was in a comatose state, due to the long period during which it enjoyed immunity from attack. It was a monopolist industry, because to engineers it offered the cheapest method of constructing basic parts. No other manufacturing process existed which could be offered as a practical alternative on a commercial basis. So the industry degenerated into a sluggard although it did not wax and grow fat, for that would have necessitated some effort in taking up the good things offered. It did not even exert itself to demand a good price for its commodity. It was so hopelessly inert that it preferred to remain in poverty, rather than make the exertion necessary to reach a more prosperous position.

Fortunately for the industry, wartime exigency would brook no delay, and demands were made which were too imperative to be ignored. Certain foundrymen began to appreciate the real possibilities of the foundry industry, and proceeded to build an organization to develop those possibilities. This development was in the direction of providing a definitely established market, which was eager to absorb all that could be produced, regardless of price, with a result that quality received little consideration. Nevertheless, the demand could not be met, and engineers turned their attention to the development of alternative processes.

The aftermath of the war brought first a brief period of prosperity, hardly distinguishable from actual wartime service. This was followed by a long period of depreciation, when the demand for castings decreased considerably. However the foundryman found that he could not resume his prewar lithargy. He soon found that, to exist, it was necessary for him to extend himself more than ever before. No longer was he the controller of the engineer. Instead of dispensing favors as in the past it was necessary to work for them. He also found many competitors for the favors.

In the meantime the possibilities of forging, stamping, etc., had been exploited and brought within range of a definite market, in competition with sand molded castings. The range has extended considerably in the past few years. However, this does not mean that the doom of the sand molded iron casting has been pronounced. The foundryman, as previously suggested, is fully alive to the necessity for action, and there is no reason to suppose that he will fail in his undertaking.

We have to realize that while the exploitation of other processes of fabrication means work lost to the foundry, to some extent, there is another and even more important aspect to be considered. Utilization of these processes on a big scale means an extended market for engineering products generally. In this connection the foundryman benefits. It is well known that the die-casting process, for example, is economical only for quantity production. Therefore where the die-casting process is utilized, there will be an increased demand for sand molded castings, for as the output of the engineer's product increases, the requirement of such parts of the product as are still sand molded castings must show a corresponding increase.

The aim of the modern engineer is to eliminate machining to the fullest possible extent. With this end in view he utilizes the primary process, whether it be the die-casting, drop forging, or the sand molded casting. It has not been shown that the latter can be beaten for general engineering purposes, either in respect to cost or utility. The sand molded casting has the great virtue of being accommodating, a vital factor in modern engineering, and if the foundryman develops his organization along the right lines, he will make the sand molded casting indispensable.

Attention is being paid to the requirements of the engineer. Although the selling price of the sand molded iron casting is higher than in prewar days, the casting, is a cheaper product to use, due to the saving in machining. During the war and the immediate postwar boom, the iron casting was an expensive article, for the engineer paid a higher price for a casting which cost just as much to machine as in prewar days. Happily, that state of affairs no longer exists.

Although sand molding lends itself to specialization, so that the service of the semiskilled or specialized operator can be employed, the necessity for skilled molders in many branches of the industry cannot be gainsaid. It is in this connection that partial failure may develop, unless immediate steps are taken to augment the ranks of skilled men. Both in America and in Great Britain there is a shortage of such men. No practical steps appear to have been taken to attract apprentices to foundry work, and the efforts of Great Britain in this respect are not bearing much fruit. At the moment the British molder is attracted to the United States by reason of the plenitude of work and the high wages offered, but as conditions improve in the British foundry industry this source of supply will cease. It behooves both countries to give greater consideration to the question of apprentices, and thus ensure, for the future an adequate supply of skilled foundry workers.

Work in the foundry is interesting, and there is no reason why it should not be made attractive. Obviously, if

(*Concluded on Page* 939)

# How Europeans Train *Men for Foundry Work*

Schools Have Been Established in France and Belgium for Training Young Men Who Desire to Qualify for Position as Master Foundrymen

**By Vincent Delport**

YEARS ago British members of the engineering profession frequently stated that no finer engineering schools than the French existed for teaching theory; but, they added, the engineer coming out of one of those schools was of no practical use until he had passed two or three years in the works, and had been confronted with actual problems that arise in practice.

My experience of 20 years ago bears out this view. However, during the past 20 years considerable progress has been made in France in the direction of practical training although much still has to be done. General engineering theory still holds a preponderant place in the curriculum of the larger schools with the result that the poor fellows, who were worked pretty hard in past years, now have to exert themselves to a still greater extent.

### Defines Engineer

The Ecole Superieure de Fonderie, or High School of Foundry, is one of the best examples of the really practical school in France, created for the purpose of producing foundry engineers. In England the engineer is the expert who drives the engine on the non-stop journey from London to Glasgow, or, his friend who drives the engine on the speed track from Catford to Charing Cross. On the continent, the engineer is a man who has gone through a course of training and obtained a diploma, or degree, at one of the engineering schools. In France, the engine driver is called a mechanician, and his mate, the stoker, is the chauffeur. Any person in France who has acquired some knowledge of mechanics and who operates a shop can call himself an engineer. Attempts have been made to legislate on the matter and reserve a title of engineer for those who have obtained a diploma in one of the recognized schools. Such legislation would be difficult to apply. To differentiate, one generally adds certain letters, or the name of his particular school after the word *engineer*.

The idea of a special school for the purpose of training foundry engineers first was expounded by M. Ronceray, chairman of the training and apprenticeship committee of the Association Technique de Fonderie in a paper which he contributed to the Liege Foundry Congress in September, 1921. Following up this idea, M. Ronceray obtained the active support of the Syndicat General des Fondeurs de France, the French employers' organization, and the scheme gradually materialized.

Government gave its support to the scheme through the channel of the department of education, and the director of technical education was delegated to keep in touch with the Syndicat des Fondeurs. If the program of the Syndicat were accepted, the ministry agreed to share in financing the enterprise to the extent of one-half the cost, the other half to be furnished by the foundrymen's association. Necessary lecture rooms, foundry, and pattern shop of the Ecole Nationale des Arts et Metiers of Paris were to be put at the disposal of the new institution. Since last year, with the exception of the foundry, the school has its own rooms and laboratories in the building of the Ecole de Arts et Metiers. On July 30, 1823, the scheme was laid out definitely by the Syndicat General des Fondeurs and communicated to the representative of the government. At the beginning of October, the names of the proposed directors of the future school were drawn up for approval. Seven members of the board were designated by the Syndicat des Fondeurs and six by the Ministere de l'Instruction Publique. On Oct. 23, the decree was signed authorizing the opening of the school with the President of the Syndicat General des Fondeurs as chairman of the board ex-officio. The school was opened on Jan. 7, 1924.

Candidates must pass a competitive examination. Foreigners and outside students can be admitted providing the number does not exceed a certain proportion. At the opening of the school, eighteen students, including one foreigner and one outside student were admitted. A regular student pays a fee of 1500 francs ($60). Foreign students and special students pay 2500 francs ($100). The course of study is comprehensive and represents the last stage in the training of the foundry engineer or manager.

### Preliminary Work

Candidates for the Ecole Superieure de Fonderie come from the foundries and from the leading engineering schools. The general method followed for the foundry candidates can be summarized as follows: Candidates must have spent at least one year's actual practice in a foundry. Dating from next year this stage will be raised to 18 months, and eventually to 2 years, because experience has shown that those who had had the most practice beforehand derived the greater benefit from the school.

## Reflects Experience

*VINCENT DELPORT, European manager,* THE FOUNDRY, *received his engineering training in one of the great Paris technical schools and therefore is in a particularly favorable position to discuss the subject of technical training as it is practiced in France and Belgium. His observations recently were presented before the London branch of the Institute of British Foundrymen. Brief reference to the same subject appeared in the April* 1, 1924, *issue of* THE FOUNDRY. *In presenting his paper recently, Mr. Delport gratefully acknowledged assistance from M. Ronceray and M. Lamoureux of the French and Belgium foundrymen's associations, respectively, who had enabled him to include reference to the most recent developments.*

Apprentices are taken in certain foundries, usually between the ages of 13 and 16. The first year they are given elementary instruction on general subjects one or two evenings a week. During the next two years, apprentices and also grown-up workmen who are willing, follow a course of professional training given in various districts where a number of foundries are grouped together. This preliminary course consists of lectures delivered in the evenings according to a program laid down by the Syndicat General des Fondeurs. At the end of this period, the apprentice who has been trained practically in the foundry, at the same time has become a qualified workman through actual experience.

If he wishes to improve himself, he follows for one year a higher course which constitutes the second degree in his training as a specialist. This higher course is given in each district and generally takes the form of Sunday lectures and exercises. The student becomes familiar with the elements of mathematics, physics, chemistry, drawing, etc.

### Prepares for Examination

The workman under consideration has been trained for three or four years. He may be employed in one plant or another. At any time he may choose to drop his studies and to remain in the ranks. Should he decide to reach the last stage and apply for admission to the Ecole Superieure de Fonderie, he will have to follow a final preparatory course for one more year. This course is given twice a week in the evenings at the various local professional schools, and prepares the student for the examination he will have to pass to be admitted to the foundry school. This examination is both theoretical and practical.

Candidates coming from recognized engineering schools must have had six months' actual practice in a foundry. These candidates take the practical examination but are exempt from the theoretical part. The other candidates, who have worked up from the shop, only take the theoretical tests.

Object of the examination is not only to eliminate candidates in excess of the fixed number, but also to be sure they have sufficient knowledge of mathematics, physics, chemistry, drawing, etc., and of foundry practice to enable them to follow the course with profit. Outside students who wish only to follow the course on certain specialities are accepted. The course lasts seven months from January 1 to July 31, the day's work lasting from 8:30 a.m. to 6 p.m., with two hours' interval for lunch.

The course consists of about 160 lectures on a variety of subjects, practical and theoretical, pertaining to foundry practice, and 70 practical exercises comprising laboratory work in the schools' laboratories and actual practice in the foundry and pattern shop which are lent for that purpose by the Ecole d'Arts et Metiers. A certain amount of time is devoted to discussion, during which the students can obtain explanations on points which have not been well understood. They are quizzed by the professors also on the subject of the lesson. Each week the students visit a foundry plant, and once a month they report on these visits.

### The Final Test

At the close of the year's work in July, a final test has to be passed by the students in the complete study of molding. In 1927 the subject was: "Molding a Tandem Cylinder for Steam Engine." At the July, 1928 examination the subject was: "A Locomotive Superheater."

The students must submit a complete study of the molding and discuss it before the board of examiners. They are questioned also on any of the subjects that have made up the whole year's course. This year they had to calculate the approximate weight of the finished casting, the weight of pig iron necessary to make the casting, the thicknesses of metal that would have to be machined, the contractions in various directions. They had to choose the manner in which they would prepare the mold, and give their reasons. They had to describe the pattern, coreboxes and cores, state the quality of sand they would use for mold and cores, describe the methods they advocated for filling the mold and state their reasons, describe the heat-treatment, if any, and calculate the time necessary to make the casting complete from the blueprint stage.

A particularly difficult item was to calculate the reactions on the cores and on the various parts of the mold. The casting was supposed to resist a temperature of 450 degrees Cent. This final test serves to classify the students as they come out of the school, but account also is taken of the average marks they have obtained during the year for their various studies, reports, etc. Even if they have satisfactorily fulfilled all these conditions, they are not granted the diploma of foundry engineer until six months after they have occupied a post in the foundry shop. At that time they have to submit a paper on a subject of their own choice and which relates to their actual experience in the foundry. If this paper is considered satisfactory the diploma finally is granted to the student. Last year, 18 students obtained the diploma of Engineer E.S.F., and for the present year, 15 candidates successfully passed the examination entitling them to follow the course. Eight outside students also were enrolled. They include one mining engineer, the son of a Paris foundryman, one Japanese professor, one foundry manager of a large Czecho-Slovak works, one Spanish and one Italian student, one Brazilian officer, one Belgian steelmaker, and, a point of particular interest, one foundryman whose intention it was to follow only certain courses relating to his own speciality.

The Syndicat des Fondeurs, or employers' organization, is using its influence to make apprenticeship compulsory in foundries of certain importance. The employers' organization has prepared a complete program on the training of apprentices.

Each year the foundry should take from five to seven apprentices for each 100 workers. Apprentices' wages should be fixed at about the same level as that of unskilled workers of the same age. In certain foundries the apprentices earn from 2 to 3 francs an hour at the end of their period of training. They occasionally receive a bonus on production, and at the end of their training they are granted the sum of 1,000 francs ($40.00). Apprentices are not recruited easily because in France, as elsewhere, the foundry profession is not attractive. To encourage boys to follow this profession, the association recommends lectures in schools, visits to the foundries, and that teachers in the primary schools should be asked to point out the advantages of the profession to their pupils.

### Favor Shop Training

The majority of foundry owners in France who have taken up the question of apprenticeship are in favor of training in the shop. They consider that the atmosphere of the shop makes for better workmen than the atmosphere of the school. Apprentices should be grouped under the direction of a skilled molder. Where that method has been employed, satisfactory results have been obtained. The training period generally is three years. Apprentices mix with the other workmen and work under the same conditions only during the third year. Only where it is impossible to organize sections of apprentices in the foundries is it recommended to have them trained in local professional

schools. The apprentice should be transferred to another foundry at the end of his period of training, but it is considered essential that the actual period of training should be spent in the one foundry. A contract should be entered into between the foundry and the apprentice's parents. This contract guarantees the terms under which the training will be effected.

In each important foundry center lectures occasionally should be given on various subjects pertaining to foundry practice. Each regional group of the Syndicat des Fondeurs is asked to organize the courses and evening lectures which the apprentices must follow. During the first year, the lectures cover the subjects of arithmetic, elementary geometry, drafting, etc. A complete program of studies for the second and third year has been drawn up by the Syndicat.

### Schools in Paris

Four schools in France give a course of general engineering and specialize on certain subjects at the end of the course; Ecole Polytechnique, Ecole Centrale des Arts et Manufactures, Ecole des Mines, and Ecole des Ponts Chaussees, all situated in Paris. The Ecole Polytechnique was founded by Napoleon Bonaparte in 1794. It is a government school and prepares, principally, artillery officers. However, the men who graduate in the first ranks obtain government posts as naval architects or in the department of mines or public works, or in the tobacco, powder or munition factories. Each year about 40 are placed in these departments, but first they have to follow a course of training, in special schools, which lasts one or two years. The other graduates form the nucleus of the artillery officers' corps.

When they have completed their period of compulsory service they can resign their commission and seek employment as engineers in a private capacity, a step which a large number of them choose to take. Many engineers of the Ecole Polytechnique are connected with the French railroads.

The Ecole des Mines trains mining engineers, and the Ecole des Ponts Chaussees, civil engineers. These schools recruit their students from the first ranks of the Ecole Polytechnique, and from other candidates who have passed the examination for admission satisfactorily.

The Ecole Centrale des Arts et Manufactures, or, as it is generally named, briefly, the Ecole Centrale, is perhaps the school in which the most complete training of a general nature is given, but where specialization is pushed to a lesser degree than in the other schools. The Ecole Centrale was founded 100 years ago by a group of physicians and chemists, of which one was J. B. Dumas. Candidates must pass an examination showing that they have a sufficient knowledge of mathematics, physics, chemistry, etc., to follow the course of studies. A young man usually closes his studies in France by passing an examination called the Baccalaureat. This is the last stage of secondary education and entitles the student who has successfully passed the examination to the title of Bachelor of Science or Bachelor of Arts. The program does not compare in strength with that necessary to acquire the degree of Bachelor in Great Britain. It would correspond probably to matriculation. A young man who has obtained his degree of Bachelor of Science in France, requires, normally, 2 years, and possibly 3 years, before he can pass the examination to enter the Ecole Centrale. Formerly, the examination for admission was passed in one session. Now it is divided into two parts, which have to be passed at one year's interval. This procedure always obtained at the Ecole Polytechnique.

### To Visit Plants

A course of studies at the Ecole Centrale extends from October until the end of June, over a period of 3 years. The morning of each day is devoted to lectures, and the afternoons are given up to drafting and laboratory work. Twice a week an hour is devoted to military training. Before the war, the practical training was limited to one or two visits each year to industrial works and a couple of topographical excursions. During the holidays it was optional for the students to visit industrial plants and facilities were afforded them.

At that time the school had a laboratory for electrical measurement, another for the study of dynamos and alternators and a laboratory for testing materials. Naturally, chemistry occupied a considerable proportion of laboratory work. Practical training at that time was limited considerably. Subject of foundry, for instance, was just part of the technology course where one was given descriptions of a mold and a cupola, how a mold was made, etc. In the past three years considerable extensions of the laboratories have rendered the curriculum of the school more practical.

Owing to the activities of M. Guillet, director of the school for the past four or five years, and whose name is well known to all metallurgists, several million francs have been collected from the principal industrial works in France. This money has been used to build complete shops in a separate building, where the workings of practically every type of machinery can be studied effectively. The students operate these machines, including molding machines and many examples of foundry equipment. Principles of practically every branch of engineering are studied during the 3-year course.

During the third year the students specilize in one of four branches: Public works, metallurgy, mechanical engineering, or chemistry. All students follow the general curriculum, but each class also takes a few extra lectures which more particularly cover the subject of the speciality that they have chosen. This specialization is more especially taken up in laboratory work and in the various practical exercises.

At the close of the last term each student must submit an essay on one of a number of subjects. This essay has for its main subject the layout and organization of a complete plant and the subject is chosen according to the specialities that the student has decided to follow. A candidate must present a paper on his subject, and a set of drawings illustrating the layout and various details of the works. A certain number of marks is allotted to this essay, and an average is worked out, taking into account the various partial examinations that have taken place during the 3 years. A general average is thus secured and to obtain the diploma of Engineer E.C.P., a minimum number of marks must be attained.

### Three Years in Paris

Highly technical education is centralized in Paris. Candidates for these schools can prepare for the admission examination in some of the "lycees" or high schools in various large towns, but they have to spend three years in Paris to complete their studies in the Engineering School. A number of local engineering schools, the Institut Industriel du Nord, the Ecole des Mines de St. Etienne, and others bear high repute. Then there are a number of highly specialized schools, such as the Ecole Superieure d'Electricite in Paris, Institut Metallurgique et Minier de Nancy, the Ecole de Travour Publics of Paris, agricultural schools, etc. An engineer who has come out of one of the four big schools can specialize at the Ecole d'Electricite, for instance, but this is rather unusual, and these specialized schools generally recruit their students directly from those who have completed their secondary education,

and passed the required exams for admission.

In quite a different sphere are the Ecoles Nationales des Art et Metiers. Two of these schools were founded by Bonaparte, one at Compicgne in 1802 and one at Angers in 1806. Later the Compicgne school was transferred to Chalons where it still exists. In more recent years, two other schools were founded, one at Angers, in 1843, and one in Paris. The foundry school is in the Paris Ecole Nationale d'Arts et Metiers. Students of these schools do not necessarily have to show proof of a full secondary education. They are given a sound technical education in higher mathematics, physics, chemistry, etc. Part of the time is devoted to practical work in the workshop.

Like the four big schools, these Ecoles Nationales des Arts et Metiers are controlled by the state. Students who have completed their studies satisfactorily are given the title of Ingenieurs des Arts et Metiers, or, Ingenieurs *A.* et *M.* The technical training is not so high as in the schools previously mentioned, but, undoubtedly, the practical training is much better. Many engineers from the foundry school have been recruited from the Ecoles Nationale des Arts et Metiers. Some of them choose to continue, and follow the higher technical courses at the Ecole Centrale or another similar school.

### Prepares Two Classes

The Ecole Superieure de Fonderie is a link between the higher engineering schools and the actual foundry. It recruits candidates from both sources. The technically trained engineer must spend a certain period in a foundry before entering the school while the foundryman must first acquire a minimum of technical knowledge. Thus, both classes of students are prepared to follow the curriculum of the school without difficulty.

Some foundrymen have worked up from the shop and attained a high position in their industry, but at the expense of a considerable number of years' toil and undirected work. An organization like the foundry school enables the ambitious foundryman to reach such a position at an early age and with a minimum of time and trouble. The apprentice who accepts the scheme of education set out for him and who starts at, say, the age of 14, may attain a responsible post in a foundry at the age of 25. He has a full equipment of technical knowledge and several years' foundry practice. This example, set by the Paris High School of Foundry soon will be followed by a school in Belgium.

The Foundry training in Belgium is not developed to such an extent as it has been recently in France. Foundry apprentices are trained in three or four schools in Belgium. Foundry courses are delivered on Sundays in a number of technical schools organized specially for foundry apprentices and workmen. An Ecole d'Arts et Metiers trains engineers for the foundry industry and other branches and there is also a foundry correspondence school. However, a superior high school of foundry shortly will be organized at the Universite du Travail of Charleroi.

### Intelligence Ranks High

It may seem strange in an industrial country like Belgium with about 800 iron, malleable, steel and nonferrous foundries, that there is not as yet a specialized school for training foremen and engineers. This is explained by the fact that the average Belgium workman generally has had the advantage of a thoroughly primary education, and his intellectual level really is high. Many workmen read a great deal and assimilate knowledge, with the result that apprentices learn their trade quickly in contact with experienced workers. In a number of important foundries in Belgium a section is organized to constitute a foundry school under the supervision of an experienced molder. Opportunities exist in every industrial district of Belgium for young men who wish to learn a trade. Many foundry foremen and foundry owners in Belgium have educated themselves, and have acquired the necessary technical knowledge in chemistry, metallurgy, and electricity in the various professional schools. Leading foundrymen of Belgium recognize that it is necessary to co-ordinate efforts and that a specialized course of training for foundry practice should be organized. The establishment of a high school of foundry at the University of Charleroi probably will be the result of these efforts.

## Requests Statistics

The apprentice committee of the American Foundrymen's association, in its May meeting, considered the advisability of securing definite information on the number of apprentices in training in the foundry industry.

Since the federal government through its biennial census of manufacturers can make such a survey, resolutions were drawn to ask the government to include this information in the report of the biennial census. The resolutions also asked that the proportion that this number bears to the number of skilled mechanics be included.

These resolutions were passed by the association and approved by the board of directors who then forwarded them to Washington.

## Foundries Train Workers

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boys are paid high wages for repetition work demanding little skill, they will not be attracted by a proposition which offers low wages at the outset, and after years of close application little opportunity for advancement beyond the skilled workman stage, the rate for which is really no higher than that paid to men engaged upon specialized and semiskilled tasks. The skilled molder in Great Britain is not fortunate in the matter of wages. Although he is much better off at the present time in the United States, he will not receive preferential treatment if business begins to decline.

Apart from the question of wages, is the bigger question of advancement. The skilled foundryman should have the right to look for a high position. Generally he looks in vain. There are more opportunities in the general engineering shop than in the foundry, and this is why the ambitious young man shuns the latter. However the possibilities arising out of the combination of chemistry metallurgy, pattern engineering, and practical molding are enormous. Now each is tested differently, and there is no combination. When foundrymen formulate an apprenticeship program which includes all of the essentials mentioned, there will be no lack of applicants, especially if the rate of remuneration during the period of training is more in accord with the rates ruling for young men in less skilled branches of industry.

It is useless telling a boy that he has greater security in the future by having a trade at his command, for his father will tell him different. He will tell him that specialization makes the call for the semiskilled man the most insistent, and that it is of no use working for years at a low rate to learn a skilled trade when the man who got high wages as a boy is getting still higher wages as a semiskilled workman.

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R. M. Porter has been added to the sales force of the Van Dorn Electric Tool Co., Cleveland. Mr. Porter will have his headquarters in Philadelphia and will cover the Philadelphia and Camden, N. J., territory.

# Bill Picks Up Some Interesting Dope in a Brass Shop

By Pat Dwyer

NOW that all the excitement is over and neighbors—some of them—are beginning to greet each other civilly, instead of glaring defiance and other obnoxious sentiments, the country and its people can go about its and their business in peace for the next four years, or perhaps it would be more accurate to say for the major portion thereof.

Preliminary work, scouting, skirmishing, mine laying, establishing observation posts, storing ammunition, arranging what the boys call safe financial contacts and all that kind of thing, will begin again in a year or two. Perhaps I am unduly pessimistic, but it would require more than a feather to knock me dead if I learned tomorrow that the sacred inner circle already is in session. Of course, I realize I have no more chance than — than — than you have, of gaining this priceless information, but you know what I mean.

A comparatively small number of people is active all the time. Some of this number are in and some are out. The *ins* draw a salary for serving the people and naturally they spend most of their time perfecting measures to insure their continued holding of office. The *outs* draw no salary, therefore they have the most compelling of all motives to keep them active on the firing line. To these people, the triumph or defeat of one party at the polls is either a glorious victory or a national calamity. The remainder of the population does not take an extreme view of the situation. They reflect tranquilly that an election is a good deal like a circus. It affords interest, amusement and a certain measure of excitement and suspense. A circus performance only runs a couple of hours while a presidential campaign—the part which the public is allowed to see—extends from the spring to the fall, with high spots at the convention, the notification and the final swing around the circle.

Bill came in the other night while I was engaged in the foregoing sage reflections. I asked him what he thought about the clever comparison I had drawn between an election and a circus. Just to be contrary, I anticipated that he would claim there was no comparison, or if he admitted a comparison, I thought possibly he might shoot off on another track and chide me for referring so flippantly to such sacred institutions as parties and elections. Somewhat to my surprise he ignored the comparison altogether.

"Well," said he, "I'll tell you. What this country needs is more and bigger circuses. Then, perhaps we could see them in action in winter as well as in summer. I saw one act at a circus this past summer that I should like to see over again."

"What do you mean, one act?" I inquired, "All circuses and all acts are alike."

"Seems to me," Bill remarked, "I have heard that clever observation before. You might just as well say all men are alike. They have the same number of feet and hands, eyes, ears and inward appendages. They all react in a practically similar manner to heat, cold, hunger and thirst. I never saw a man who would not jump and yell if jabbed suddenly with a pin or other suitable sharp instrument. For at least a considerable part of his existence each man is covered with more or less luxuriant thatch of hair on top of his head. From sweet sixteen to seventy-two he spends on an average of $12 a year in keeping this top knot trimmed, a total of $672 sacrificed on the altar of vanity. This calculation does not take into account the vast sums spent by young bloods for googum to hold it in shape or the still greater sums spent by the older new-bloods in a vain and pathetic attempt to coax a few strands out of a surface about as fertile as that on a china nest egg. All men, at least all men living in civilized communities, wear the same style and practically the same number of garments. The number varies in conformity to the climate. Men vary to some extent in length, width and cubic displacement, but if you were to catch 1000 men from one town and weigh

FAMOUS PAINTING NO. 13 *THE STAG AT BAY*

them in a block, then take a second group from another town and treat them in a similar manner, you would not find 10 pounds variation between the two lumps of humanity.

"However, don't forget young feller-me-lad, that is a long way from saying all men are alike. Heredity, environment, education and opportunity, with a capital *O*, play important parts in the lives of men, but that does not alter the fact that mankind is divided into two main classes, the self starters and those that must be cranked.

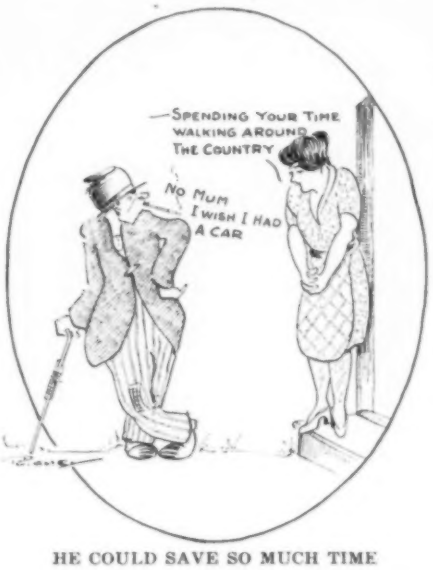
"In these modern days with machines and mechanical equipment of all kinds playing such a prominent part in the foundry industry, the individual molder has little opportunity for displaying either ingenuity or initiative. He simply is a small cog in an exceedingly big wheel. He can and does drop out with alarming frequency and never is missed. Another bit of raw material is taken from the pile that always is available. It is shoved into place with hardly any noticeable whittling and the wheel keeps on turning.

"He performs his part in a perfectly satisfactory manner and the castings toward which he has contributed his mite of labor, are just as good as those made by the most highly skilled mechanic who has made the drawings, the patterns, the molds and cores and then made up the charges and melted the metal. As a means to an end, one man is just as necessary as the other, but for some reason, probably early association and environment, the feeling of respect and admiration I entertain for the second man is conspicuous by its absence when I contemplate the attainments of the first."

"You do not need to waste any sympathy," I said, "on the men you refer to as cogs. They are perfectly satisfied and in many instances make more money than the highly skilled sand artists who, as you say, can start a job in the drafting room and carry it right through to the machine shop. Indeed in the olden time I have known foundrymen who could and frequently did, set up a job in the machine shop and finish it as good as any machinist that ever carried a chew of tobacco and a micrometer. Why, when I was a young fellow—"

"Sure," Bill interrupted. "When you were a young fellow molders were *molders*. Naturally, some were better than others. Even the run-of-mine molders were fairly handy, ingenious lads while others exhibited a positive genius in developing methods and rigging for handling the work. Manual skill was raised to a high state of perfection. A sixth sense by which a man could determine the amount of metal required to fill a mold, and the weight necessary to hold a cope in place was common to nearly all molders who had worked many years at the trade. Attainment to this position involved many years of study and close application. These men had just as much reason to feel proud of their accomplishments as men who had attained prominence in any other of the myriad divisions and, subdivisions of the great field of human endeavor.

"The fact that they toiled in the




HE COULD SAVE SO MUCH TIME

gloom and murk of the foundry helped to keep their lights hidden under a bushel, or maybe it is more appropriate to say a half inch riddle. Some of these men were home guards who never wandered away from the shop in which they had served their time, while others were gentlemen of fortune who tarried only for brief periods at the various oases in the desert.

"Closing the saloons practically has ruined this royal road to adventure. Here in last month's *Journal* I see where 8 cards were received and 12 cards granted in this great foundry town. I can remember the time when the list of names under the heading of 218 occupied nearly half a column. There may be other reasons for this alarming shrinkage in the tourist industry, but by and large I am afraid the eighteenth amendment to the well known Constitution will have to stand the major part of the blame."

"Bill," I said, "If you think you are going to involve me in an argument on that question you have another guess coming. Prohibition is a dead issue. It served as a handy political football since it was kicked off—kicked is good—in Houston and Kansas City, but with the official closing of the season, Nov. 6, it was put away definitely and will be heard of no more for four years. Maybe not then, if the astute managers of the big teams can dig up a more burning issue. Peace to its ashes. Let it rest, whether it was a real live issue, republican version, or merely a dead red herring, democratic version."

"Well," said Bill, "I'll tell you. I had no intention of dragging this prohibition thing in by the tail when I started. It just seemed to ooze in by itself as it seems to have been doing all over the country for the past few months. What I had in mind when I started was the recollection of many interesting things I saw and heard one day recently while visiting the foundry of a friend of mine. Everything about the shop reflected the presence of a clever, ingenious foundryman, familiar through many years of training and experience with every little trick of the trade.

"He operates a general jobbing foundry and turns out all kinds of nonferrous castings. Some of the orders call for a considerable number of duplicate castings, but usually they are of the short order variety. A few of this and a few of that and please let us have 'em right away. The aluminum is melted in an iron pot over a gas flame and this man has installed a pot that promises to last for an unlimited time as opposed to the pots formerly in use that had to be discarded in about 10 days. The day he showed me the pot it had been in use for about four months and showed not the least sign of wear. In addition, it was only about one-half the thickness of the old style pot and consequently cut from 20 minutes to half an hour from the melting time of the first charge in the morning.

"Brass and bronze in the 1001 combinations to which these metals are subject, are melted in a battery of coke-fired, pit furnaces in which the covers come flush with the floor in the most approved manner. Instead of the usual brick, these furnaces are lined with special blocks shaped to the desired radius and circumference. Partly owing to their composition and size and partly owing to the minimum number of joints, these blocks constitute a lining that must not be mentioned in the same breath with an ordinary brick lining. A lick of claywash around the inside each day keeps the lining in trim

for an indefinite period. A row of fire brick is built on top of the blocks and immediately under the cover plate. Practically all the wear and tear comes on this row of brick. It is renewed easily.

"An individual or special mixture of metal may be melted in each pot in the battery, or a uniform class of material may be charged in every pot to make up a sufficient quantity of molten metal to pour a large casting. This method of melting the metal insures maximum flexibility of operation, and is particularly suitable in this foundry where castings are made in wide variety. Distribution of aluminum to the molds is secured by dipping it out of the large iron pot, previously mentioned, into heated crucibles in which it is conveyed to the molds. Most of the aluminum castings are made from the well known commercial alloy, 92 per cent aluminum and 8 per cent copper, but any one or more of a dozen combinations are produced with equal facility to meet customer's requirements.

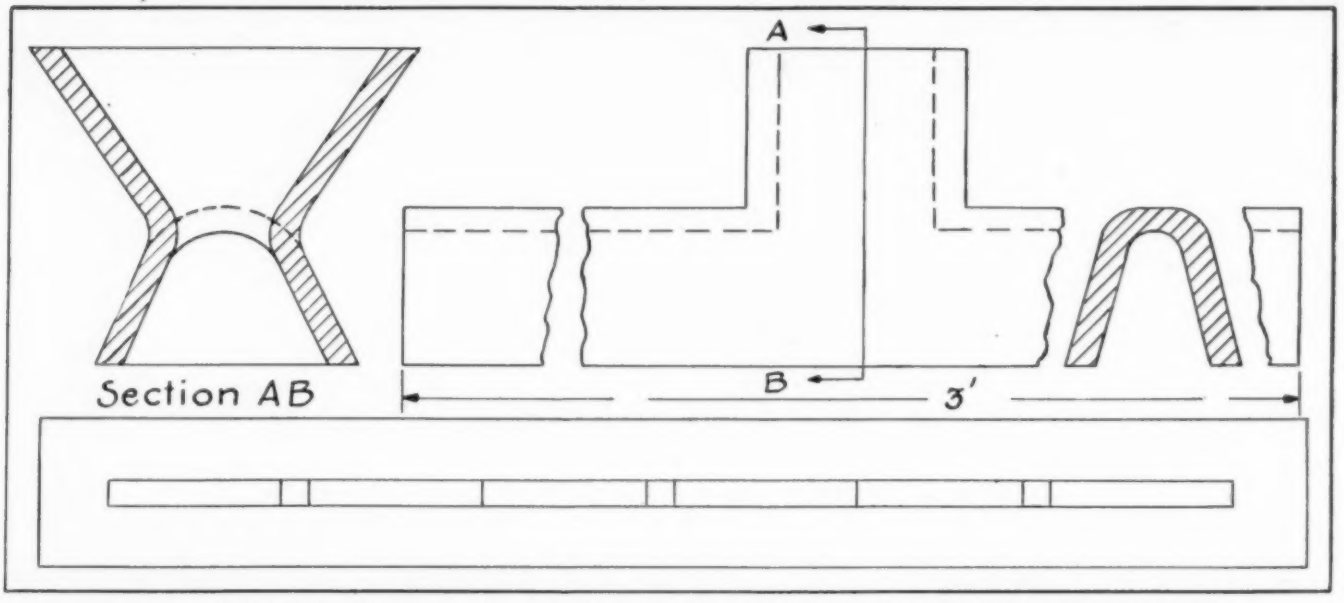
"Just as an instance of the many short cuts and clever kinks he has introduced I'll tell you about a cast iron runner basin he uses for pouring aluminum into a casting 1½ x 10 feet, ½-inch thick and containing 3200 tapered ½-inch openings. In other words a screen plate with more holes in it than you could find in a Swiss cheese. This job presents a nice problem in deciding the most advantageous points to set the gates to fill the casting in a minimum time and at the same time introduce it in a manner that will not wash the cores. I forgot to say the pattern—also made of aluminum—leaves its own cores. Fortunately the plate presents a plain 2-inch border without any holes. A similar strip extends longitudinally through the center where it is crossed by transverse bands located about 18 inches apart.

"A thin, flat gate stick 3 inches in width and tapering in thickness from ½-inch at the top to ¼-inch at the bottom where it rests on the pattern, is placed at each intersection of the central and transverse strips. After the cope has been rammed the sand on top is slicked around these gate sticks for a distance of about 2 inches on each side and almost for the full length of the cope. The gates sticks then are withdrawn.

"Under ordinary conditions a long runner basin would have to be built on top of the cope to conduct the metal from one or more ladles or crucibles into the numerous upright gates. Building a runner of this kind occupies some time, besides introducing the hazard of loose sand present always in runner basins built up in green sand. This man I am telling you about kills two birds with one stone. He uses a ready made cast iron runner basin which has been used repeatedly and probably will last forever. The runner is made in 3-foot sections and thus may be extended to fit any cope within reason. In this particular instance three sections are placed in a row to form a continuous runner over the upright gates in the cope. Three crucibles are employed to pour the metal. Here I'll make you a sketch of the thing and you can see what it is like."

The attached drawing has been taken from Bill's original sketch. The wavy freehand lines have been straightened, but otherwise it is substantially the same as Bill's first effort.

The lower part of the drawing simply shows the outline of the top of a cope with three sections of the cast iron runner basin in place. The small square in the center of each section represents the opening into which the metal is poured. The upper figures illustrate the device on an enlarged scale. It is shown in the position in which it is placed on the cope. Thus the long body of the basin is inverted from the position it would occupy as a sand basin. In effect it is a cover instead of a basin. The flat sand surface around the gates forms the bottom of the basin, while the cast iron runner serves as a cover.




CAST IRON RUNNER BASIN FOR POURING ALUMINUM INTO A LONG THIN CASTING NOT DRAWN TO SCALE

Small risers taken from several points on the rim of the casting indicate when the mold is filled. Pouring then ceases and the metal drains to a considerable extent from the runner.

"As I said in the first place," Bill concluded, "or anyway as I intended to say, you cannot tell by the look of a frog how far he can jump. You cannot tell what a man can do unless he has the chance. Many men with the noblest aspirations constantly are hampered by a cruel fate. Witness the incident of the benevolent old lady who remonstrated with a hobo for his method of living. 'Are you really content,' said she, 'to spend your life walking around the country begging?' 'No lady,' the truthful bum replied with the most charming naivette. 'No, lady, I ain't. I'll tell the world I ain't. Manys and manys the time I wished I had a car!' "

# Cleaning Room Progress Aids Production of Quality Castings

By Frank G. Steinebach

## Part XV

VERSATILITY has become a governing factor in the selection of equipment for the various departments of a modern foundry. Probably this is true more especially in the jobbing foundry, where the diversity of product results in so many different conditions under which equipment must operate. However, every type of foundry is guided by that factor to a greater or less degree. Usually, the equipment for handling materials in the foundry cleaning room possesses that important quality.

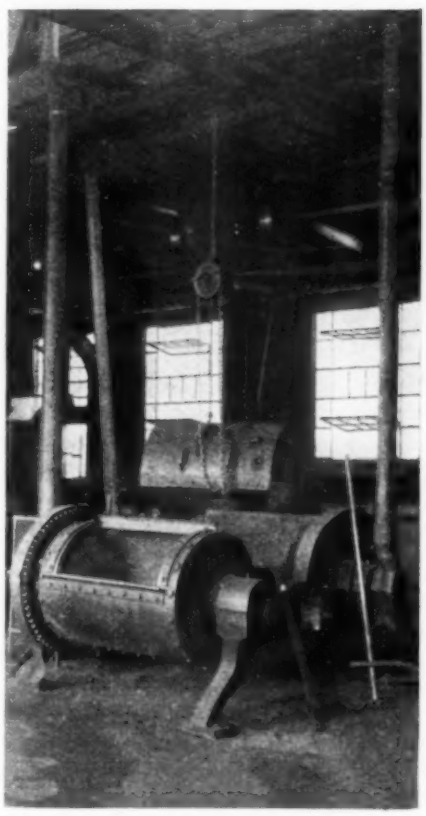


FIG. 109—A CHAIN HOIST LIFTS THE LID OF A TUMBLER

Hoists are employed extensively in handling materials throughout the foundry and especially in the cleaning department. A variety of reasons may be advanced for the large use of this equipment, including the ease with which they may be moved from one department to another, or from one place to another; compactness; simplicity of construction; and the ease with which the equipment may be controlled. The three general types of hoists which are used in the foundry cleaning room are chain block, pneumatic and electric.

Several types of chain hoists are on the market, including the single spur geared, the multiple spur geared, the screw geared and the differential type. The spur-geared type, chain hoists are used extensively in the foundry for handling heavy loads rapidly. The classification is divided further into triple geared, both the planetary and the gyratory types, single geared and multiple geared. The planetary type, chain hoist consists in general of an endless hand chain which passes over a hand wheel. The hand wheel turns on the screw hub of a ratchet friction disk which is keyed to a one piece drive shaft and pinion. The pinion meshes with two gears held diametrically opposite each other in a pinion cage which is secured to the load sheave carrying the load chain. Intermediate pinions, which are integral with the diametrically opposite gears, mesh with a large internal gear and serve as a fulcrum to rotate the planetary gear. Power applied to either side of the hand chain loop causes the drive pinion to rotate the gears in one direction or the other and in turn results in the intermediate gears and pinions rotating the pinion case. The pinion case is secured to the load sheaves so that the movement is carried to the load sheave and the load is raised or lowered. A pawl, which engages the ratchet disk when the pull on the hoisting side of the chain is removed, prevents the load from slipping.

When the lowering side of the chain is pulled, the hand wheel chain is unscrewed from the hub of the ratchet wheel. This releases the drive shaft and permits the weight of the load to rotate the planetary gear. When the operator stops the move-

FIG. 110—CHAIN HOIST EQUIPPED WITH A HAND POWERED TROLLEY

ment of the chain, the hand chain wheel again is screwed into the ratchet disk and the movement of the load is arrested. When this type of crane is made in the larger capacities, it is made with two gear trains which are held in separate gear cases. These gear trains are connected by a yoke and are operated by separate hand chains, although a single hoisting hook is used.

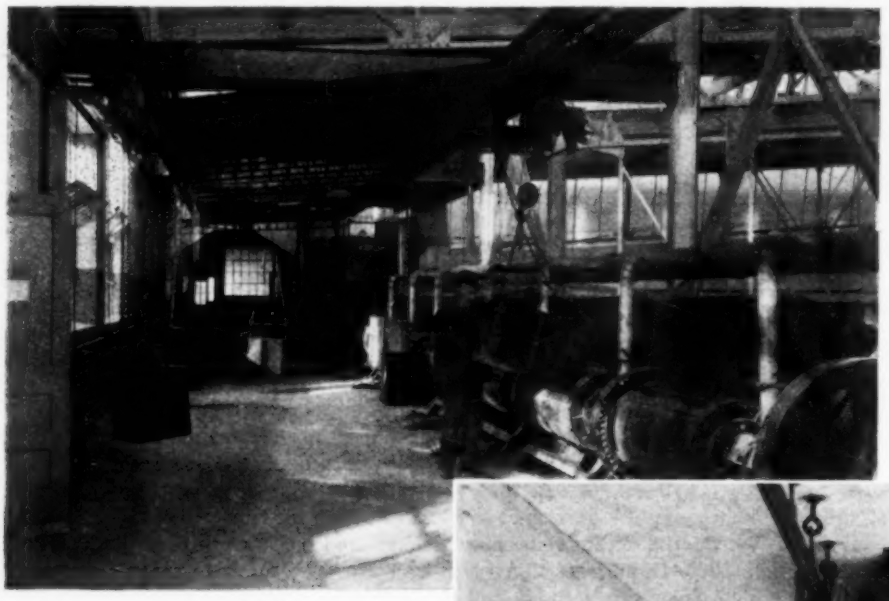
In the triple, spur-geared, chain hoist of the gyratory type, a floating duplex internal gear cut in a two part yoke is used. In a gear train of three gears, the shafts of two outer gears have double eccentrics. The central shaft is secured to the power sheave shaft which passes through the hollow lift wheel shaft. The lower teeth on the lift wheel mesh with the lower teeth of the two part yoke and the upper teeth with the upper teeth of the yoke. Movement of the hand chain moves the train of gears and results in a gyratory motion being imparted to the two part yoke by gear train. The hoisting hook is raised or lowered by the movement of the load sheave resulting from the yoke rolling the lift wheel within the duplex internal gear.

The differential hoist is designed with two pocketed, chain sheaves, cast together and having slightly different diameters. One loop of an endless chain carries the load hook with its sheave and the power is applied by hand to the other loop. The screw geared chain block has a worm and a worm gear which hold the suspended load by the friction of the worm thread. Several of the manufacturers of chain hoists use antifriction bearings in the construction of chain blocks.

Air hoists are of either the cylinder or the motor type. Cylinder hoists may be classified further into single acting, air balanced and double acting. The single acting hoist is constructed so that compressed air is admitted to the under side of the piston for raising the load and is exhausted to lower the load, no pressure being maintained in the upper cylinder. This type of unit is quick acting, but it cannot be used where delicate control is required. In the balanced-type, lift hoist, full air pressure is maintained constantly on the under side of the piston. The load is raised by exhausting air from the space above the piston and is lowered by admitting air above the piston. The air under the piston merely surges back and forth from and to the supply line as air is exhausted or forced into the chamber above the piston. Accuracy of control is a feature of the balanced type pneumatic hoist. The balanced hoist also is built with a load retaining feature. The hoist is equipped with a friction collar on the piston rod which controls a valve and admits automatically a sufficient amount of air to make up for leakage or a change of pressure.

In the double acting type of cylinder hoist, air may be exhausted or admitted to either side of the piston alternately. This type of hoist may be placed in the vertical position and used either for pushing or pulling. When equipped with a continuous piston rod and a stuffing box in each head, either a pushing or a pulling force may be applied at either end of the device. Where the head room is limited, the cylinder hoist may be arranged in the horizontal position with a rope attached to the end of the piston and passed over a sheave. With either the vertical or the horizontal hoist just described, the lift is equal to the distance of travel of the piston. However, with the horizontal hoist, multiple sheaves may be installed and the stroke compounded 2 to 1, 4 to 1 or 6 to 1.

The motor type pneumatic hoist has been developed considerably in recent years and now is used extensively in foundries. The hoist consists of a small, cylinder-type pneumatic motor which drives a hoisting drum through a spur gear or a worm gear reduction. Several types of motors are used, including the oscillating cylinder type, the rotating cylinder and the reciprocating square piston type. The oscillating cylinder type motor has two double cylinders set at right angles to each other. The oscillation of the cylinders alternately opens and closes the air ports. The control valve is located on the motor and is regulated through chains which



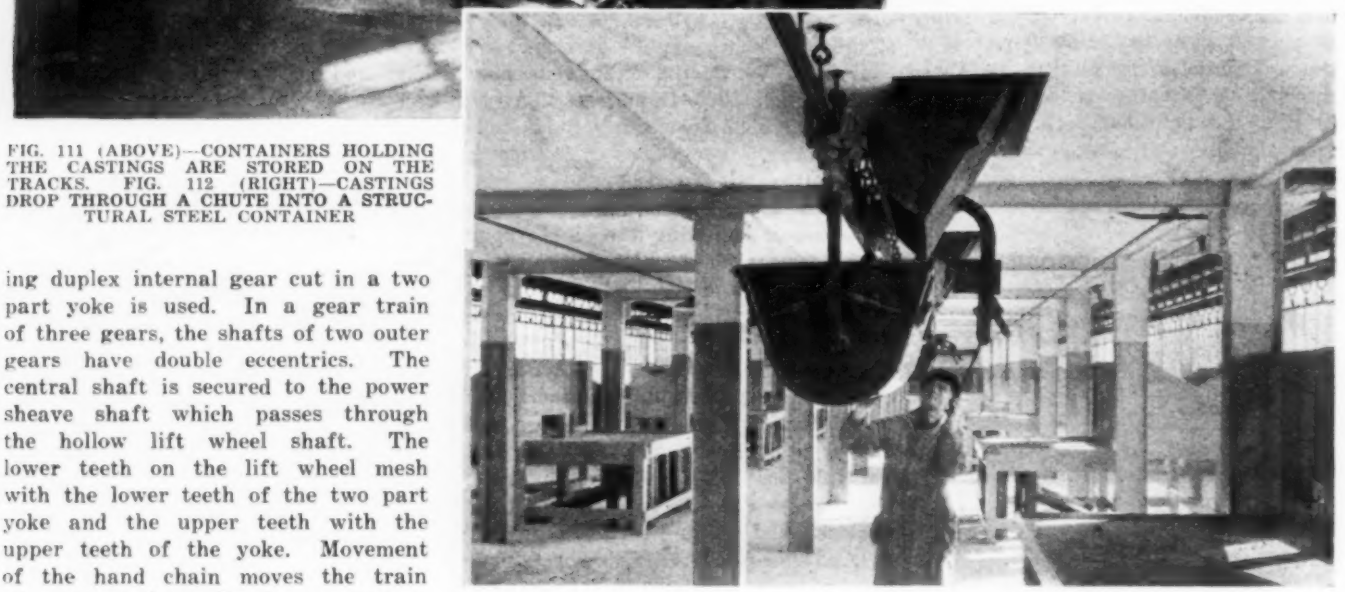


FIG. 111 (ABOVE)—CONTAINERS HOLDING THE CASTINGS ARE STORED ON THE TRACKS. FIG. 112 (RIGHT)—CASTINGS DROP THROUGH A CHUTE INTO A STRUCTURAL STEEL CONTAINER

are within reach of the operator on the floor. Some manufacturers place a safety clutch in the worm gear to hold the cable tight in the drum grooves and to prevent uncoiling or kinking. A safety stop is provided to regulate the height of travel of the hook.

The rotating-cylinder type motor is designed with three cylinders which are grouped radially around a crank shaft. The cylinders rotate around the shaft and air is admitted to the cylinder or exhausted through ports in the crank. This type of hoist may be operated in either direction simply by pulling on one or the other of two control chains attached to the valve on the motor. The reciprocating type motor consists of a slide-valve double engine in an exceedingly compact form. The unit has an inner and an outer piston. The pistons, on reversing type engines, take air from a center port located in the cover or front section of the piston chamber, and exhaust it through a ring shaped port, if operating in one direction. Air enters through the ring and exhausts through the other port when operating in the opposite direction.

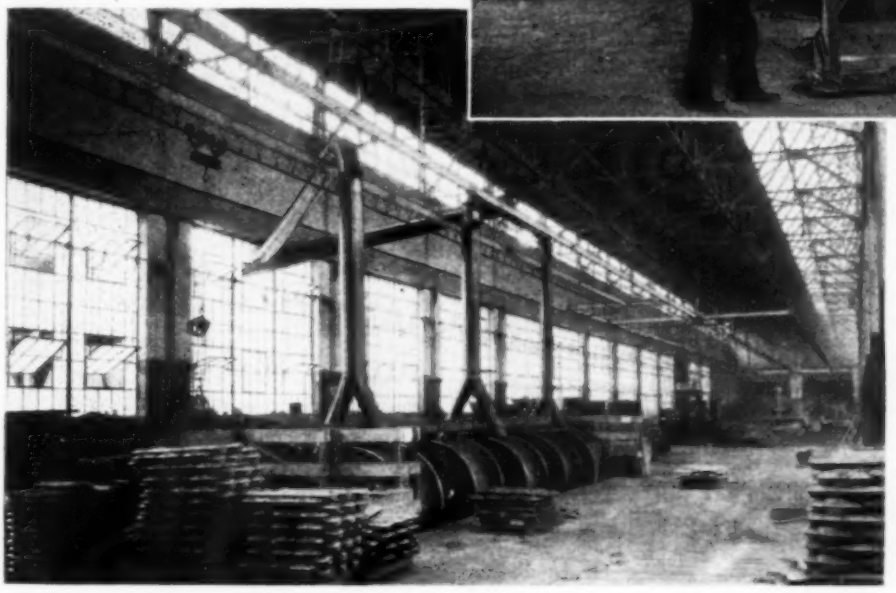


FIG. 114 (LEFT)—MONORAIL TRACK INSTALLATION OVER TUMBLERS. FIG. 113 (ABOVE)—CASTINGS MAY BE CARRIED FROM THE MOLDING FLOOR TO THE CLEANING ROOM ON THIS CARRIER

Due to high efficiency, great flexibility and ease of control, electric hoists are used extensively in handling materials in the foundry industry. While the designs of the various manufacturers differ more or less in certain details, the electric hoist consists of an electric motor, either alternating or direct current as the power supply necessitates, which drives a drum through a set of reduction gears. Either worm gear or spur gear types may be used and in some cases a combination of both is employed. The motor may be equipped with either a single speed or a variable speed controller. When variable speed is desired, the controller usually is of the drum type and it may be placed on the crane so that it may be controlled by chains; it may be placed in some part of the building for remote control, or it may be placed in the cab of a crane which supports the hoist.

A mechanical motor brake usually is provided to permit absolute control of the load. Several types of motor brakes are used, including a shoe-type brake which is operated automatically by the controller, and a magnetic brake. Anti-friction bearings usually are used throughout. The gearing and other mechanism of the hoist is enclosed and runs in oil.

While the various types of hoists which have been described often are attached to a stationary support and are used for one particular operation, such as loading castings into sandblast barrels or tumbling barrels, the great majority of hoists which now are being installed in the modern cleaning department are supported by some type of traveling unit. The I-beam crane with a trolley supported hoist was mentioned in a previous installment of this series of articles. The monorail is used extensively to provide a means of transportation for the hoist. The power hoist may be equipped with a geared trolley so that it will travel under its own power, or it may be built with a plain trolley.

Numerous types of monorail now are used. In some cases a plain I-beam is used to support the wheels of the hoist trolley, while in others special shapes are rolled to provide certain features of performance. The shape of the track affects the design of the trolley. If the surfaces on the rail over which the wheels travel are horizontal, the trolley wheels may be assembled in a vertical position, while if the bearing surfaces of the rail are slightly inclined to the horizontal, the wheels often are built at a slight angle to the vertical. The tracks are supported by various types of hangers, the strength and number of supports needed depending largely on the weight of the materials to be transported.

An interesting application of monorail equipment is shown in Figs. 111 and 112. The tumbling department of a hard iron foundry is shown in Fig. 111. Castings are brought from the molding department in the metal containers suspended from the plain trolley, and are stored on a system of parallel tracks as shown in the illustration. Thirty-seven of these tracks, each set 2 feet apart, are provided. As tumbling barrels be-

come available, the castings are dumped with the aid of the electric hoist which travels over the I-beam trolley, as shown in Fig. 111. The hoist also is used to remove the covers from the tumbling barrels. After the castings are tumbled, they are dumped directly from the mills into a chute in the rear.

The castings fall through the chute into the special steel tub, which will dump the load in either direction. The load then is carried to the desired sorting bin and dumped. Since one of the tedious and often expensive operations in the small jobbing shop is sorting castings, special attentions has been given to eliminating as much of the sorting work as possible in the shop where the equipment illustrated in Figs. 111 and 112 is installed. The carriers, shown in Fig. 111 are large enough to hold the production from one molding floor or one section. When full, the carrier holds a charge for the tumbling barrel. The work is organized so that not more than eight different patterns ever get to one sorting table.

Equipment for transporting castings from the foundry to the cleaning department is shown in Fig. 114. In the great majority of monorail installations, the cleaning room unit is only a part of the foundry system. In this way, materials may be handled in and out of the various departments with ease, and intradepartmental handling also may be accomplished effectively.

While many hoists of the floor operated or controlled types have been equipped with trolleys operating on a monorail track, the term monorail hoists has been reserved by engineers to designate that type of hoist which has a cab attached to a structural steel frame. The trolleys are swiveled so that the unit may travel around a curved track. The unit may be equipped with one or two electric hoists which are controlled from the operator's cab.

This is the fifteenth of a series of articles describing equipment used in the cleaning room. The sixteenth will appear in an early issue.

## Produces Pure Manganese

Bureau of metallurgical research, Carnegie Institute of Technology, has devised a process for the production of pure manganese. This metal never has been prepared in the pure form in any great quantity although it is used widely in both the ferrous and nonferrous metal industries.

Ordinary processes of reduction of manganese from its ores yield a product which is contaminated with several per cent of impurities. Electrolytic methods so successful in the treatment of many metals, are not applicable readily to the purification of manganese.

The method used for the purification of this metal is a vacuum distillation process. Metals of low melting point such as mercury, cadmium and zinc, have been purified by distillatin and the method of distillation developed at Carnegie institute is considered significant because of the high melting point of manganese, 1244 degrees Cent.

The process used at the bureau of metallurgical research is described as follows: Crude metallic manganese was placed in a pure magnesia crucible over which a similar crucible was inverted to condense the distilled metal. The crucibles were placed inside a silica tube 4 inches in diameter and two feet long which was closed at both ends and connected to a vacuum pump. The middle portion of the tube was surrounded by a water-cooled, copper coil of about 30 turns through which an alternating current of several amperes at about 20 kilocycles was passed. This induced eddy currents in the manganese that heated it to the melting point. A pressure of less than one twenty-thousandth of atmospheric pressure was maintained in the silica tube by the vacuum pump. The molten manganese boiled at this low pressure and evolved manganese vapor which condensed in the upper crucible. The metal formed by the condensation of the manganese vapor had a high degree of purity.

The pure manganese has a bright, silvery luster and will not tarnish on exposure to air. It is extremely brittle and hard enough to scratch glass.

This method of purification of manganese was the result of research by Drs. F. M. Walters Jr., V. N. Krivobok and J. B. Friauf. Samples of the pure manganese and the furnace in which it was produced were shown at an open meeting of metallurgists held Oct. 19 in Pittsburgh under the auspices of the metallurgical advisory board which co-operates with the department of metallurgical engineering of Carnegie Institute of Technology and U. S. bureau of mines in a program of metallurgical research.

## Issues Catalog

The Cleveland Crane & Engineering Co., Wickliffe, O., has issued a catalog describing its material handling equipment. The book is illustrated adequately with drawings, illustrations and photographs of typical installations. Beside the material handling equipment, the catalog describes many of the accessories which this company manufactures and illustrates their uses with photographs and drawings. Directions for the installation of the material handling equipment also is given. The latter part of the book is devoted to the description of the cranes which this company manufactures.

## Charles Vickers Says

(*Concluded from Page* 933)

of the alloys produced by brass foundries. However, whenever the highest grade of material is demanded of the foundryman, whether pure copper, or high tensile alloys, only the purest materials should be used, chief of which is copper. Impure materials are handicaps against success.

The conductivity of copper properly treated with boron suboxide flux may be as high as 97 per cent according to the statements of Dr. Weinstraub, but 90 per cent only is claimed. The physical properties obtained are stated to be 24,350 pounds per square inch tensile; 11,450 pounds per square inch elastic limit; 48.5 per cent elongation in 2 inches, and 74.49 per cent reduction of area. Conductivity tests made on a cast bar 24 inches long, machined from 1-inch diameter to ¾-inch, gave 75 per cent electrical conductivity, using 1 per cent boron suboxide flux per 100 pounds of copper. If an increase of 15 per cent is allowed when drawn into wire, the conductivity would be 90 per cent, or two per cent higher the silico-calcium deoxidized copper.

## Forms New Company

The Belgian firm of Schippers & Podevyn has absorbed the Ateliers & Fonderies Schippers & Podevyn and the Fonderies Mecaniques d'Anvers. The name of the new company is Nouvelles Fonderies Mecaniques Schippers Podevyn, Hoboken, Antwerp, Belgium. The company operates cast-iron, bronze and aluminum founderies, mechanical workshops and a brass stamping shop. The general manager of the new company is Rene Pierard, the technical manager is Louis van Hoofstadt, and Francois Podevyn Jr., is commercial manager.

## Opens New Office

Vanadium Corp. of America, 120 Broadway, New York, has opened an office at 2245-2246 Henry W. Oliver building, Pittsburgh, under the direction of J. Alfred Miller, Jr., general manager of sales of the corporation.

# WHAT OTHERS ARE THINKING

*Abstracts Selected from the World's Foundry Literature*

### Studies Fuel Combustion

*The Fuel Economy of the Cupola*, abstract of article by R. W. Mueller in *Giesserei-Zeitung*, No. 14, 1928, published in the *Foundry Trade Journal*, London, Sept. 27, 1928.

The author made several experiments to determine the influence of the cupola blast, maintaining the coke charges constant, and the influence of the coke charge, maintaining the blast constant, on the output and thermal efficiency of the cupola. The cupola melting zone diameter was 27.56 inches enlarged to 39.37 inches above the melting zone, and the cupola had two rows of tuyeres. The bed of the cupola consisted of 900 pounds of coke and 297 pounds of limestone. The iron charge was 1100 pounds. During the melting period the mixture was changed 4 times, interspersing a charge of coarse coke between changes. Mueller found that when the coke charge is normal, the output and the temperature of the iron and slag decrease with decreasing amount of blast. The ratio of combustion and thermal efficiency are not influenced except to a slight degree. When the amount of blast is normal, the output, thermal efficiency and combustion ratio decrease with increasing amounts of coke. On the other hand temperatures of iron and slag increase. Mueller also concluded that the amount of coke charge is determined by the inner diameter of the cupola, and that exceeding the normal coke charge has a more deleterious effect than a moderate lack of blast for some time.

### Discusses Formulas

*Evaluation of the Properties of Cast Iron from Formulae*, by J. E. Hurst, *Foundry Trade Journal*, London, Oct. 18, 1928.

In this article which was presented as a lecture at a meeting of the London branch of the Institute of British Foundrymen, Mr. Hurst discussed the various formulas and diagrams that have been presented from time to time to prognosticate desirable structures in cast iron. One such formula presented by German investigators is

$$Sc = \frac{C}{4.26 - \frac{Si}{3.6}}$$

where C represents the total carbon content, Si the total silicon content, and Sc a coefficient or constant. For general castings, Sc=0.9 to 1.0 per cent; for locomotive castings, Sc=0.8 to 0.9 per cent; for internal combustion engines, Sc=0.76 to 0.85 per cent; for ingot molds, Sc=0.71 to 0.83 per cent, and for hard cast iron, Sc=0.75 to 0.88 per cent. Mr. Hurst believes that this formula and many others are open to the objection that they are based only on a silicon and total carbon summation, and do not take other variables into consideration. He included the diagrams of Maurer, and Greiner and Klingenstein in this objection. Thrasher's diagram according to the author is the most satisfactory of the simple diagrams published. This was published originally in the December, 1915, issue of THE FOUNDRY, and consists of curves showing the relation of the silicon content, total carbon content, and the thickness of the test bar. Mr. Hurst believes that this method could be extended to cover all possible conditions. This could be accomplished with a series of diagrams.

### Makes Statuary

In his presidential address at the meeting of the Lancashire branch, Institute of British Foundrymen, and published in the *Foundry Trade Journal*, Oct. 11, 1928, E. Longden described the making of two bronze busts by the lost wax process. Contrary to the usual practice, these castings were made head down. The core was made in loam approximately the size and shape of the finished casting. After drying the core is modeled roughly to the size of the finished casting, and then about ¼-inch of the surface is removed for the metal thickness. After blacking the core soft wax is applied to the surface to give a layer of about 5/16-inch thick The wax then is modeled to the shape and contour of the subject. A 1/16-inch layer of paste compound composed of plaster of paris, brick dust and blacking is washed over the surface and allowed to dry. Two further layers of the same composition minus the blacking follow the first coat and are allowed to dry. This object is placed in a flask and the space filled with brick dust and plaster. After drying for three days the mold is placed in an oven and baked for three days to remove the wax and dry the mold thoroughly. The castings were poured with a bronze mixture containing 88 per cent copper, 7 per cent zinc and 5 per cent tin.

### Tests Molding Sands

*Ueber Formsandpruefung*, by P. Aulich, *Die Giesserei*, Dusseldorf, Sept. 21, 1928.

This article is from a paper presented by the author at the July, 1928, meeting of the German Foundry association. It deals with the testing of molding sands and covers the methods used for determining the quality of sands for foundry use. First the author describes the method used for determining the amount of sand or quartz grains, and the amount of clay. This is done by agitating the sand with water. The turbid liquid containing the clay is decanted, and this process is repeated until all clay is washed from the sand. The author recommends boiling the sands in water for complete removal of clay in fat and medium fat sands. The method of determining the grain sizes by sieving is described. This is done on the dried sand from the previously described test.

Methods of determining permeability, shear strength and transverse strength. Permeability is determined by the standard apparatus adopted by the American Foundrymen's association. Shear strength is measured on a machine developed by Dietert. Transverse strength is found by pushing a rammed bar on oiled paper over a sharp edge at a speed of about 6 inches per second until the end breaks off. The part broken off is weighed and the value expressed in grams. In conjunction with the text the author gives several diagrams and results obtained from tests performed on sands.

### Describes Cost System

*Rapid Costing for Small Foundries*, by Jaime Coll y Soriano, *Foundry Trade Journal*, London, Sept. 20, 1928.

This article is taken from a paper presented at the Foundrymen's convention held at Barcelona, Spain, in which the author describes a cost system which is applicable to small foundries producing less than 500 tons a year. The author first determines the cost of molten metal based on the most frequent tonnage melted. He then makes out a table having the following nine headings: "Weight of each casting," which is scaled in 10 steps from 2.2 pounds to 2 tons; "Useful weight required," which is standardized at 220 pounds; "Unusable," which is standardized at 17 pounds or 8 per cent; "Runners, etc.," where for 220 pounds of castings weighing 2.2 pounds each, 440 pounds are allowed, while at the other end of the scale, that is for a 2-ton casting, only 18 pounds for each 220 pounds weight is allowed for runners; "Total," is the sum of the weights given in columns 2, 3 and 4, and in the case of 220 pounds of 2.2-pound castings it amounts to 220+18+440=678 pounds. In the case of a 2-ton casting, it is only 225 pounds. "Melting losses," 7 per cent. In case when making 220 pounds of castings weighing 2.2 pounds each, a simple calculation shows that 47 pounds has to be added. Column 7 has three headings, namely, "Weight to be melted." "Cost per 220 pounds at the spout," and "Cost of metal." Thus for each 220 pounds of usable castings weighing 2.2 pounds each, the weight to be melted is 678+47 (melting loss)=725 pounds. Column 8 has the heading, "To be deducted for reclaimed metal." This is the sum of columns 3 and 4 multiplied out at $3.30 per 220 pounds and in the case of castings weighing 2.2 pounds each is 458 at $0.015—$6.86. The last column is "Costs of the metal per 220 pounds of salable castings." This is plain subtraction of the figures in column 8 from column 7 and in the case of castings weighing 2.2 pounds is $6.48 or $0.0294 a pound. For 2-ton castings the final figure is $4.53.

# The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

## ¶ Uniformity in Trade

TRADE practices constitute the rules under which those active in manufacturing or mercantile pursuits play this absorbing game of life known as business. Fair play is the fundamental principle upon which trade practices are established and maintained. However, in business, as in every game which engages human interest, officials who apply the rules are necessary. In the past eight or ten years, the federal trade commission, appointed by the President and confirmed by Congress has played the role of the official rules body.

IF THIS comparison of business to a great national game may be continued, the more recent attitude of the federal trade commission may be likened to that of the rules officials or referees, who periodically call conferences to determine changes and improvements in the code. A series of trade practice conferences has been held, many times at the instances of those active in an industry and occasionally at the invitation of the commission. This procedure deals with an entire industry as a unit. It concerns itself with practices and methods and not with individual offenders. In this the commission differs from a punitive body and becomes more directly an adviser group. Each industry is privileged to present its list of practices, enumerate abuses which are unfair and discuss the entire business procedure of an industry. Those who attend may do so without prejudice. Participation in no sense is an evidence of previous indulgence in practices which may be either approved or condemned.

AMONG the numerous conferences which have been held and which have resulted in resolutions supporting certain trade practice codes, many interesting points have been developed. A conference of the oil industry, held in 1920 shows a case in point. Among the rules adopted is the following:

> *Sales on a Quality Basis*—What we strictly desire to encourage is the sale of products on the basis of quality and intrinsic value. Salesmen should be encouraged to explain diligently and carefully the merits of their particular line and a fair and reasonable profit over and above the cost of the material itself, the distribution cost and a reasonable amount of overhead and profit is to be heartily commended.

This rule implies in many ways the certification of product adopted by certain groups of the foundry industry and further enunciates the principle of a fair profit, which needs adherence in this industry.

A CONFERENCE of the millwork industry in July, 1928, shows many forward steps in the matter of trade practices. Perhaps some of the jobbing interests in the foundry industry might have profited in 1921 by the application of the following rule from the millwork code:

> *Selling Without Specifications*—The acceptance by wholesale distributors and manufacturers of contracts for the sale of millwork to dealers or wholesale distributors of this product without statement of specifications, affords opportunity for the rejection of such contracts by the purchasers on decline of price, provides an artificial stimulus to the industry through the existence of large numbers of unconfirmed contracts, with resulting enhancement of prices to consumers and constitutes unfair trade practices. . . .

STILL more far reaching is a rule recently adopted at a conference of the wax paper industry. Under the heading, "Selling Goods Below Cost," a principle is laid down, which while tacitly understood, never has been adopted previously by action of those engaged in manufacture. This rule states:

> *Selling Goods Below Cost*—The selling of goods below cost, except to meet a price offered by a competitor, is an unfair trade practice. Such a practice eliminates competition regardless of efficiency, results in great loss to the industry, encourages price discriminations which may affect other industries, and is an unfair trade practice. It is the judgment of this conference that every manufacturer of waxed paper should install a cost system which will enable him to accurately determine his costs.

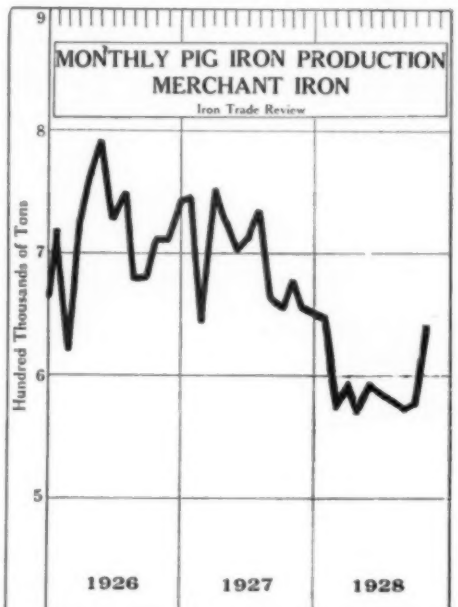
In its role as an official of the game, would the federal trade commission be the proper channel through which to bring about uniform foundry trade practices? If so, should the trade associations of the foundry industry, such as the Malleable Iron Research institute, the Steel Founders' Society of America and the Gray Iron institute seek to interest the commission in calling a general conference of the entire foundry industry? Consideration and comment by leading castings manufacturers are in order.

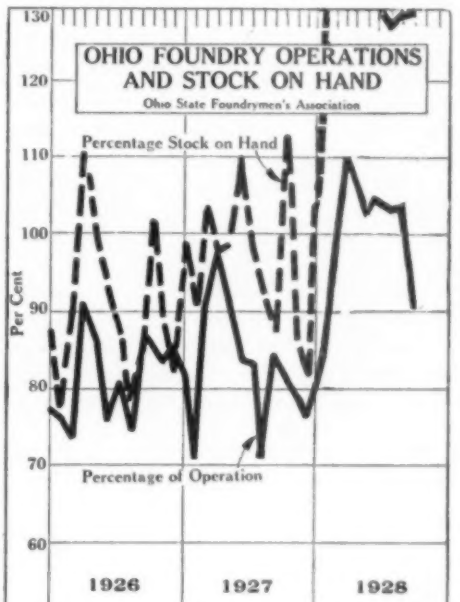
# Trade Trends in Tabloid

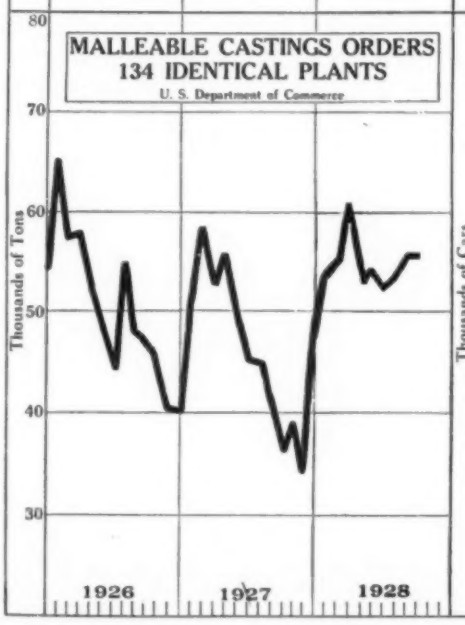
BUSINESS is good in the foundry industry. Even the railway car orders which have lagged throughout the year, seem to be increasing. The melt has increased in practically every district. Rising prices are prevalent in both pig iron and scrap, with some prospects of a shortage of basic and perhaps foundry grades in the first quarter of 1929. Eastern foundries are working at the highest rate of the year. Implement shops report greater activity than has been experienced in the past four years. An electrical machinery builder in the west has jobbed some castings requirements, due to the inability of its own foundries to supply its needs. Stove and radiator shops are booming. Automobile manufacture continues at a high rate. Pig iron production for October, according to *Iron Trade Review* was the highest for the year, with a total of 3,373,539 tons. The daily rate of production was 6.5 per cent higher for October than for September. Merchant iron totaled 643,043 tons for October, compared with 580,344 tons for the preceding month. Monthly average prices for nonferrous metals, according to New York quotations in *Daily Metal Trade* through October, follow: Casting copper, 15.183c; electrolytic copper, 15.442c; lead, 6.50c; Straits tin, 49.039c; aluminum, 23.90c; antimony, 11.007c. Zinc averaged, 6.25c, E. St. Louis, Ill. Upward trends are observed in metal prices.

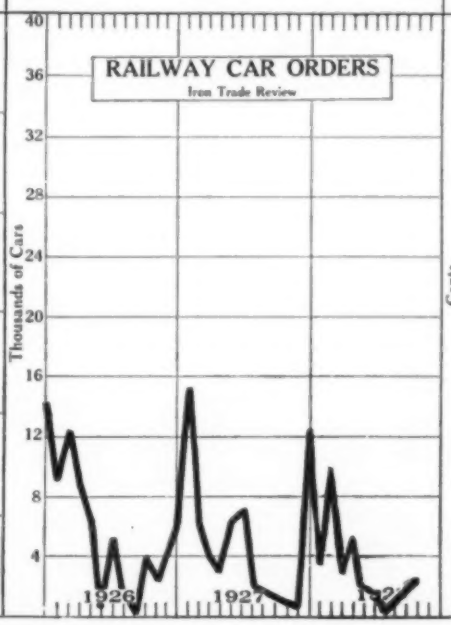
**RAW MATERIAL PRICES**
**Nov. 7, 1928**

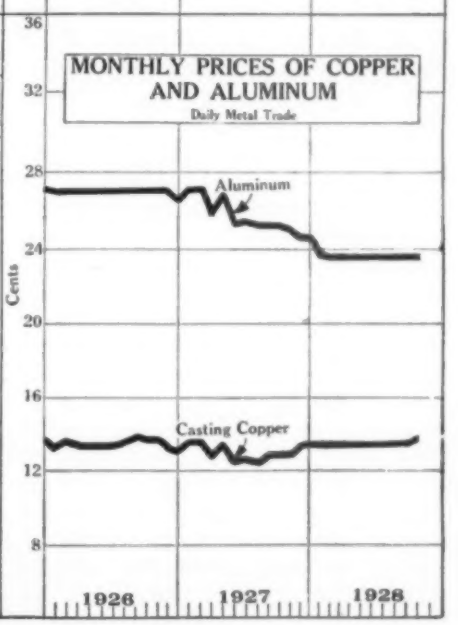
| | |
|---|---|
| **Iron** | |
| No. 2 foundry, Valley | $18.00 |
| No. 2 southern, Birmingham | 16.25 |
| No. 2 foundry, Chicago | 20.00 |
| No. 2 foundry, Philadelphia | 20.76 to 21.26 |
| No. 2 foundry, Buffalo | 18.50 |
| Basic, Valley | 18.00 |
| Basic, Buffalo | 17.50 |
| Malleable, Chicago | 20.50 |
| Malleable, Buffalo | 19.00 |
| **Coke** | |
| Connellsville foundry coke | $3.75 to 4.85 |
| Wise county foundry coke | 4.50 to 5.25 |
| **Scrap** | |
| Heavy melting steel, Valley | $16.25 to 17.00 |
| Heavy melting steel, Pitts | 17.50 to 18.00 |
| Heavy melting steel, Chicago | 14.50 to 15.00 |
| Stove plate, Buffalo | 14.50 to 15.00 |
| Stove plate, Chicago | 12.00 to 12.50 |
| No. 1 cast, New York | 13.00 to 13.50 |
| No. 1 cast, Chicago | 15.70 to 16.25 |
| No. 1 cast, Philadelphia | 16.50 to 17.00 |
| No. 1 cast, Pittsburgh | 15.25 to 15.75 |
| No. 1 cast, Birmingham | 14.50 to 15.00 |
| Car wheels, iron, Pittsburgh | 16.00 to 16.25 |
| Car wheels, iron, Chicago | 14.00 to 14.50 |
| Railroad malleable, Chicago | 15.50 to 16.00 |
| Agricultural mal., Chicago | 13.00 to 13.50 |
| Malleable, Buffalo | 15.50 to 16.00 |
| Railroad malleable, Pitts | 14.00 to 14.25 |
| **Nonferrous Metals** | Cents per pound |
| Casting, copper, refinery | 15.75 to 16.00 |
| Electro, copper, producers | 16.00 |
| Straits tin | 49.12½ |
| Lead, New York | 6.50 |
| Antimony, New York | 10.25 |
| Nickel, electro | 37.00 |
| Aluminum, No. 12, producers | 23.00 |
| Aluminum, No. 12, remelt | 15.50 to 16.50 |
| Zinc, East St. Louis, Ill. | 6.25 |



# Comings and Goings of Foundrymen

**Men of the Industry, Whose Activities Are Making Foundry History**

HAROLD C. OSMAN, secretary, Nugent Steel Castings Co., Chicago, has been named works manager. Mr. Osman, previously was connected with the American Steel Foundries for ten years where he served as special apprentice, metallographist, supervisor of government orders during the war and as night manager. He entered the employ of the Nugent Steel Castings Co., then the Electric Steel Co. in 1922, as sales engineer. After a short time, he was appointed sales manager and in 1926 was elected secretary of the company.

George L. Bitting has resigned his position as director of sales for the Bunting Brass & Bronze Co., Toledo, O.

Joseph T. Gough has resigned his position as safety engineer at the Massena, N. Y., plant of the Aluminum Co. of America and plans to enter business for himself.

Allen H. Warner has been elected president of the Sherman Mfg. Co., Battle Creek, Mich. Mr. Warner was chosen to fill the vacancy left by the death of Howard B. Sherman, founder of the company.

Donald P. Ordway, a director of the Sherman Mfg. Co., Battle Creek, Mich., has been elected vice president of that company.

Walter M. Buttell recently has accepted a position as foundry superintendent for Fay & Scott, Dexter, Me. Mr. Buttell has held various positions with the Milford Iron Foundry, Milford, Mass., Baxter D. Whitney & Son, Wincherton, Mass., Record Foundry & Machine Co., Livermore Falls, Me., Manufacturers Foundry Co., Waterbury, Me., and the Springfield Foundry Co., Springfield, Mass.

William H. Edsall, vice president of the H. L. Judd Brass Manufacturing Co., Wallingford, Conn., tendered his resignation, effective Nov. 1. His resignation is forced because of ill health.

James D. Rhodes, president of the Universal Pipe & Radiator Co., New York, has returned from Europe.

At a meeting of the board of directors of the United Engineering & Foundry Co., Pittsburgh, Oct. 23, the resignation of F. C. Biggert Jr., as president of the company was accepted. Mr. Biggert expressed the desire to be relieved of the business management of the company as he believed his value to the company would be materially increased if his entire time could be devoted to matters of engineering and research. Mr. Biggert was elected vice president and senior engineer.

George T. Ladd was elected president and general manager of the United Engineering & Foundry Co., Pittsburgh, to succeed F. C. Biggert. Mr. Ladd comes to the company from

HAROLD C. OSMAN

the International Combustion Engineering Corp. where he was vice chairman, as well as president of the Ladd Water Tube Boiler Co. and the Heine Boiler Co.

T. R. Berkley, formerly plant manager of the Holmes Foundry Co. Ltd., Sarnia, Ont., Canada, has accepted a position as foundry superintendent of the Oakland Motor Car company's foundry, Pontiac, Mich.

L. M. Mullholland, for the past ten years general foreman of the Holmes Foundry Co., Port Huron, Mich., has been appointed plant manager of the company's plant at Sarnia, Ont., Canada.

Edgar A. Eckhouse, president of the Central Brass Mfg. Co., Cleveland, has been elected a director of Scher-Hirst Inc., clothing manufacturers.

Sidney J. Newman has been elected president of the Newman Mfg. Co., Cincinnati, succeeding Samuel Newman, who died recently. Walter J. Newman is vice president and Emil C. Newman, secretary and treasurer of the Newman company.

W. P. Bradley has been made foundry superintendent of the National Steel Foundries, Milwaukee. Mr. Bradley formerly was connected with the Wheeling Mold & Foundry Co., Wheeling, W. Va., and for 25 years was foundry superintendent for the American Bridge Co., Ambridge, Pa.

F. E. McIntyre has resigned his position as foundry superintendent with the National Steel Foundries, Milwaukee.

## Hold October Meeting

The October meeting of the Buffalo Foundrymen was held at the club rooms of the organization, 140 Chandler street, Buffalo, Oct. 24. Vernon Wells, a representative of the Carborundum Co., Niagara Falls, N. Y., gave a talk on abrasives and modern foundry grinding methods and explained an educational film entitled "The Jewels of Industry," which dealt with the manufacture of abrasive materials which the Carborundum Co. makes.

## Group Changes Name

American Engineering Standards committee, 29 West Thirty-ninth street, New York, has changed its name to American Standards association. This group was organized in 1917 by the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers and the American Society of Testing Materials. The association consists of 37 member bodies and 350 sustaining members including manufacturers, distributors, associations, etc. U. S. departments of agriculture, commerce, interior, and labor are member bodies as are the U. S navy department and war department. The purpose of the organization is to provide a method of co-operation which will prevent duplication in standardization work and prevent the circulation of conflicting standards. W. J. Serrill, assistant general manager of United Gas Improvement Co., Philadelphia, is president of the association.

## Book Review

*Automotive Grinding*, by Fred B. Jacobs, cloth, 146 pages, 6 x 9 inches, illustrated, published by The Penton Publishing Co., Cleveland, and furnished by THE FOUNDRY for $2, and in Europe by The Penton Publishing Co. Ltd., Caxton House, London, for 10s.

Precision grinding on a production basis as practised today is a direct result of the stupendous American automobile manufacturing industry. While the automobile business made production grinding possible on a large scale, it also is true that hundreds of ceramic, abrasive and mechanical engineers, toiling patiently year after year in grinding wheel and grinding machine manufacturing plants have made possible the splendid results of today. The present volume outlines the underlying principles of successful abrasive practice. In arranging the material for this work, a careful selection was made to include every important phase of automotive grinding. As a reference work for superintendents, abrasive engineers, grinding room foremen, grinding machine operators, and students of abrasive engineering methods, the book will serve as a standard of the best modern practice. It shows how work is ground advantageously and how high production is maintained. Not alone in the automotive field will the methods outlined prove of value, as they can be applied to practically all branches of manufacturing where high production necessitates the best abrasive practice.

Fully 90 per cent of all the abrasives used are of two kinds—carbide of silicon and manufactured alumina. The manufacturing processes followed in making abrasives are described briefly and an interesting grade scale is given, comparing various grade designations. Another important feature is a complete list of the trade names used by grinding wheel manufacturers. Under the subject of grinding machines the author describes the various types of equipment as usually found operating on production work in automobile manufacturing plants.

Various processes of cylinder finishing are described. At least eight methods have been used. These are described fully. Camshaft and crankshaft grinding also are detailed at length and an interesting crankshaft honing machine is described. Various piston manufacturing methods are detailed and data also are included on the manufacture of piston rings. Internal grinding comes in for a fair share of attention, while a chapter is devoted to centerless grinding. Other chapters take up the subjects of disk grinding, automobile body finishing, grinding and grinding wheel supervision. The book is well illustrated.

## British Society to Celebrate Birthday

The Institute of British Foundrymen will celebrate its twenty-first birthday at a meeting to be held in London, Eng., March 6, 1929. Dr. Walter Rosenhain is president of the institute and will preside at that gathering. The fall meeting of the institute will be held in Dusseldorf, Germany.

During the year 42 papers will be presented at meetings of the six local sections of the institute. Several of the papers will be discussed at joint sessions with other societies such as the Institute of British Foundrymen, Birmingham Metallurgical society, Staffordshire Iron and Steel institute and Institution of Engineers and Shipbuilders in Scotland.

### Faked Foundry Facts

Put in a New Bar

## Hold November Meeting

The Chicago Foundryman's club held its regular November meeting Nov. 1 at the City club, Chicago. R. S. Dean, Western Electric Co., Chicago, gave an illustrated lecture on "Recent Discoveries in the Science of Metals That Effect Brass Foundry Products."

## Obituary

John F. Lonergan, for many years head of the Lonergan Foundry & Machine Co., Philadelphia, died of bronchial pneumonia Oct. 23 at Sacramento, Calif., at an age of 88 years. Mr. Lonergan was the inventor of several railroad devices.

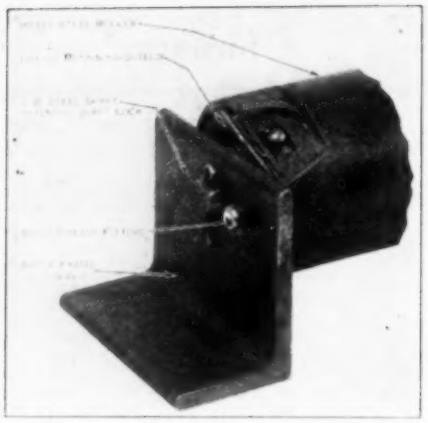
James A. Smith, for the past 15 years superintendent of the Schenectady plant of the General Electric Co., died at his home in Schenectady, Oct. 25 from a stroke of paralysis. Mr. Smith was born in Hartford, Conn., May 25, 1873, and worked on a farm during his youth. From 1888 to 1901 he was employed in various capacities by Pratt & Whitney, Hartford, Conn.; from 1901 to 1902 he was associated with the Niles-Bement-Pond Co.; from 1905 to 1910 he was superintendent of the Dutchess Tool Co., Fishkill Landing, N. Y. In 1910 he entered the employ of the General Electric Co., Schenectady, N. Y., as assistant to the mechanical superintendent. In a few months he was made superintendent of one of the shops and July, 1913, was appointed general superintendent of the plant.

F. Birger Klein, aged 65, who was in charge of research for the Union Switch & Signal Co., Swissvale, Pa., for several years, died Oct. 26, at his home in Wilkinsburg, Pa.

W. L. Velie, president of the Velie Motor Corp. and the Velie Monocoupe Aircraft Corp., died Oct. 24, at Moline, Ill. He was 62 years old. Mr. Velie was a grandson of John Deere, founder of Deere & Co., makers of agricultural machinery.

## Gives Data on Cupola

J. S. McCormick Co., Pittsburgh, recently has issued a folder giving data on cupola efficiency. The folder explains how to calculate the ratio of coke to iron in a cupola and also the amount of air necessary to react with the carbon to melt a given amount of iron per hour under various conditions. The feature of the folder is the table on the last page which gives the volume of air per minute and quantity of coke per hour necessary to melt given amounts of iron per hour in melting zones of various sizes. The table also gives the horsepower and the power consumption of the motors which this company provides for various sized cupolas.



THE UNIT IS EQUIPPED WITH BALL BEARINGS

## Pack Conveyor Bearings with Grease

The Standard Conveyor Co., North St. Paul, Minn., has developed a roller type conveyor with a bearing which may be packed with grease. The conveyor is designed primarily for use where exceptionally smooth operation is essential, such as in handling flasks and unbaked sand cores. While the rollers ordinarily are not machined, where absolute concentricity is essential, the face may be machined.

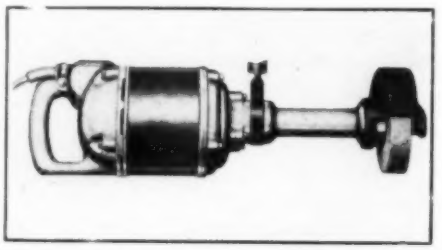
The outside diameter of the roller, shown in the accompanying illustration, is 2⅞ inches and the bearing has 12 steel balls ⅜-inch in diameter and equipped with a grease retaining ring and a grease fitting. The grease fitting projects through the angle frame. The shaft is 13/16-inch in diameter and has one end milled to prevent rotation. Conveyor units packed with grease also may be supplied in other types of construction.

## Telephone Company Gives Figures

The American Telephone & Telegraph Co., 15 Dey street, New York, announced recently an additional expenditure of $11,042,000 for the construction of new long-distance telephone facilities during 1928. An idea of the amount of material involved in such an enterprise may be secured from the following figures. The program involves the use of 22,282,000 pounds of copper wire in cables and 21,994,000 pounds of copper wire in open wire lines. Cable sheaths used will require 39,283,000 pounds of lead and 413,000 pounds of antimony. A total of 4,126,000 pounds of paper will be used in conductor insulation. The proposed program includes extensions and additions to lines in all parts of the country and to the three transcontinental routes. These will provide new carrier current circuits, radio program transmission lines and private wire facilities.

## Builds Electric Grinder

Hisey-Wolf Machine Co., Marshall and Colerain streets, Cincinnati, recently introduced a new portable electric grinder of ½-horsepower size, using a grinding wheel measuring 6x1¼ inches with a ¾-inch hole. The device is designed to operate from alternating or direct current. For single-phase current a commutating-type, repulsion-induction motor is standard; and for 2-phase or 3-phase current a squirrel cage motor is used. A compound-wound motor is employed for direct-current service. The cast-steel wheel guard, as shown in the accompanying illustration, is adjustable and can be placed at any angle most convenient for the operator. The end cover is removable, affording quick renewal of grinding wheels. A two-pole control switch is located at the grip handle. The grinding spindle is equipped with roller bearings and operates at a no-load speed of 3425 revolutions per minute on the alternating-current type and 3550 revolutions per minute on the direct-current type.



THE GRINDER HAS A CAST STEEL GUARD

## Recommends Increase in Fluorspar Tariff

In accordance with the usual custom, officials of the tariff commission refuse to discuss the fluorspar report. However, it is understood that the commission has taken official action on the report and that it will be forwarded to the President soon. The report is understood to be favorable to a tariff increase of 50 per cent, the full amount allowable under the flexible tariff section of the law.

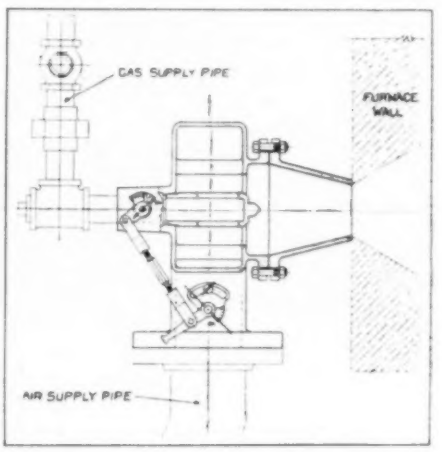
The present rate of duty on fluorspar is $5.60 per long ton or $5 per short ton, and with the 50 per cent increase, the duty would be $8.40 per long ton or $7.50 per short ton. The application for an increase in fluorspar duty was made to the commission by the domestic producers.

The statement of information made public some months ago by the commission indicated that the cost of production in the United States was higher than the foreign cost of production by more than the maximum permissible increased duty under the law on the bulk of the product. The preliminary report showed a justification for the increase and it will indicate clearly by its cost figures that a tariff increase should be made.

In 1927 shipments of fluorspar from domestic mines aggregated 112,546 short tons, valued at $2,034,728, or a decrease of 13 per cent in both quantity and total value, as compared with 1926. The general average value per ton f.o.b. mines of shipping points for all grades in 1927 was $18.08 which is 12 cents lower than the average in 1926. The general average value of the fluorspar shipped to steel plants in 1927 from the Illinois-Kentucky district was $16.59 per ton and from the Colorado-New Mexico district was $13.72 per ton. This difference in average values represents chiefly economic factors in marketing rather than differences in quality of fluorspar from the two districts.

## Burner Uses Natural or Coke Oven Gas

American Heat Economy Bureau Inc., 926-930 Wabash building, Pittsburgh, recently introduced a new-type gas burner using natural or coke oven gas, for firing metallurgical furnaces by the forced-blast principle. The burner consists of a central gas nozzle surrounded by a concentric mixing chamber into which the air from a surrounding air chamber is directed with a whirling motion by vanes. The gas enters the mixing chamber through slots in the side of the gas nozzle. Either cold or preheated air may be used but provision is made




GAS AND THE AIR INLET VALVES ARE CONNECTED

in the case of highly preheated air to bring the point of the mixture close to the furnace inlet by increasing the length of the gas nozzle. Both the gas and air inlet connections are equipped with adjusting valves. The operating levers of these valves are connected to each other through a link, as shown in the accompanying diagram, so that if the flow of gas through the burner is changed, the flow of air is correspondingly changed. Means are provided also for adjusting the link motion so that an oxidizing, neutral or reducing flame may be obtained from the burner. The unit is made in various sizes.

## Blower Impellers Have Flywheel Effect

Several changes in design recently have been made in the line of blowers manufactured by the Connersville, Blower Co., Connersville, Ind. By increasing the weight of the impellers and by more exact balancing, it is claimed that the impellers have been given a new high inertia value or flywheel effect which reduces the angular distortion and permits a reduction in the clearances between moving parts. It also is claimed that the flywheel effect distributes the working load more evenly over the entire circumference of the gear.

The blower now is equipped with a renewable, split sleeve, ring oiling bearing. This bearing has a thick lining of babbitt in a cast iron shell and is designed for the heavy duty requirements of the blower. The bearing permits the shafts to be aligned easily. The shell is split along the horizontal center, so that the top half of the bearing may be lifted off by removing the cap. The lower portion of the old bearing then may be rolled from under the shaft and a new section slipped into place. The bearings are interchangeable on machines of the same size.

## Designs Vertical Type Speed Reducer

The D. O. James Mfg. Co., 1120 West Monroe street, Chicago, recently has introduced the vertical type heavy duty worm gear speed reducer resigned for vertical driving with the drive shaft projecting at the top or the bottom. The gray iron housing is of ample size provided with a large oil cooling and heat radiating chamber. Antifriction bearings support both sides of the gear shaft. The worm shaft on one side is mounted on double bearings made by the Timken Roller Bearing Co., Canton, O., and on the other side by roller bearing made by the Norma-Hoffmann Bearings Corp., Stamford, Conn. It is claimed that this bearing arrangement insures the absorption of radial and end thrust loads, eliminates excessive heating and reduces wear of both the worm and the gear. Gear shafts are 0.40 carbon steel, ground to size and made oversize to withstand emergency strains and starting loads. Worms are made integral with worm shafts of nickel chromium steel. Gears are of phosphor bronze, the larger sizes being made up of a bronze ring shrunk on and keyed to a cast iron spider. Twenty degree to thirty degree pressure angle teeth are standard depending on a number of teeth in the worm and gear.

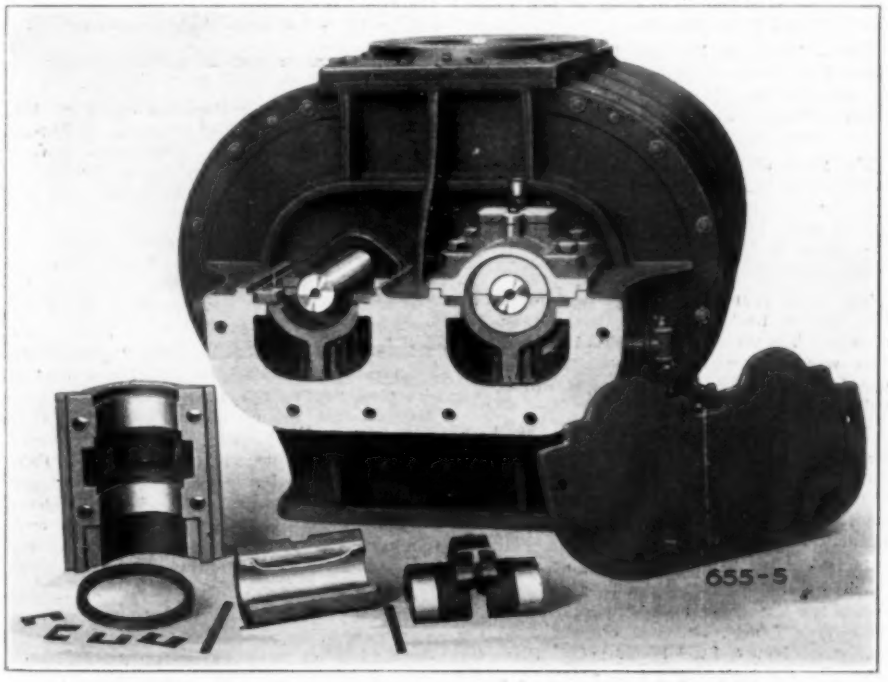
ANTIFRICTION BEARINGS ARE USED ON BOTH SIDES OF GEAR SHAFT

## Gives Data Collected on Foundry Supplies

The department of commerce has issued a statement that, according to data collected at the biennial census of manufacturers taken in 1928, the establishments engaged primarily in the manufacture of foundry supplies in 1927 reported products valued at $11,635,000. In addition, foundry supplies are made to some extent by establishments classified in other industries. The value of such products has not been ascertained. The establishments classified in this industry are those engaged in the manufacture of foundry facings, molding sand, cement for castings, core oils and compounds, chaplets, wax, flux, parting composition, flasks, sieves, pipe blacking and plumbago. Facings and supplies made by foundries for their own use are not reported separately. Of the 65 establishments listed in the 1927 report, 23 were located in Ohio, 18 in Pennsylvania, 9 in Illinois, 5 in New York, 3 in Michigan, 2 each in Alabama and Connecticut, and 1 each in Indiana, Massachusetts and Virginia.

## Gives Data on Exports of Foundry Equipment

The department of commerce, bureau of foreign and domestic relations, Washington, has issued data on the exports of foundry and molding equipment for the month of July. The report states that 1,209,813 pounds of equipment were shipped during that month with a total value of $113,037. Canada was the largest importer accounting for 1,090,429 pounds valued at $60,929 and New Zealand was second with 26,920 pounds valued at $15,656.




A RENEWABLE TYPE BEARING NOW IS USED ON THE BLOWER

# What the Foundries Are Doing

## Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Advance Stove Works, Evansville, Ind., was damaged by fire recently.

Detroit Ring Casting Co., Plymouth, Mich., suffered damage to its spark plug manufacturing plant Oct. 12 by fire.

Erb-Joyce Foundry Co., Howell, Mich., plans the construction of a new building at the Vassar plant.

Owosso Foundry Co., Owosso, Mich., has put on a night shift and is in operation now 24 hours per day.

Carey Brass Foundry, Wilmington, O., sustained a $7000 loss when it was destroyed by fire on Oct. 17.

Palm Beach Foundry & Machine Co., Putnam road, West Palm Beach, Fla., was completely ruined by the storm which invaded that section some time ago.

Griffin Foundry & Mfg. Co., Rome, Ga., was damaged by fire Oct. 10. Plans for rebuilding the plant have been started already and work is expected to be under way soon.

Davenport Machine & Foundry Co., 1628 West Fourth street, Davenport, Iowa, manufacturer of machinery and fabricator of structural steel, is building an addition.

Mid-States Steel & Wire Co., Crawfordsville, Ind., has awarded the general contract for a 1-story foundry, 85 x 245 feet, to Warner & Wirt, Crawfordsville.

Cleveland board of education, F. G. Hogen, East Sixth and Rockwell, director, received bids Nov. 12 for a 1 and 2-story foundry addition. (Noted Sept. 15.)

Centre Foundry & Machine Co., Wheeling W. Va., plans to enlarge its plant at South Warwood. It is planned to build an addition 100 feet south of the present plant.

Fire damaged the plant of the Atlanta Plow Co., Atlanta, Ga., recently. Work will start immediately on the rebuilding of the damaged departments.

Pittsburgh Foundry & Machine Co., Thirty-sixth street, Pittsburgh, William A. Smith president, plans the construction of a foundry building.

Quaker Metal Products Co., Philadelphia, has been incorporated with $20,000 capital by Louis Levy, 5941 Pine street, Philadelphia, to manufacture and deal in metal devices.

West Hudson Foundry & Pattern Co. Inc., Kearny, N. J., has been incorporated with $50,000 capital by Anthony A. Calandra, Newark, attorney.

P. C. Gibson & Co., Terminal building, Waukegon, Ill., has been incorporated with $25,000 capital to manufacture and deal in castings, stampings, etc., by R. M. and V. M. Hubler.

Sivyer Steel Casting Co., Milwaukee, is completing work on a one-story foundry addition, 48 x 52 feet and a new power house 70 feet square at West Milwaukee.

Banner Brass Foundry, 1807 Washington street, Cedar Rapids, Iowa, is considering the erection of a new foundry, 40 x 100 feet. The building and equipment will cost about $24,000.

Nelson Mfg. Co., 928 Chestnut street, St. Louis, is planning an addition to its manufacturing plant. It will be 150 x 257 feet and with equipment will cost about $250,000.

Blackhawk Foundry & Machine Co., Davenport, Ia., reports business good. It has acquired an entire block adjacent to the plant for future growth.

Ohio Pattern Works & Foundry Co., Cincinnati, has awarded a general contract for a 4-story and basement addition to cost about $150,000.

Metals Casting Inc., Newark, N. J., has been incorporated with $125,000 capital to manufacture castings by Fast & Fast, Newark, attorneys.

Minneapolis Threshing Machine Co., Hopkins, Minn., has let general contract to C. F. Haglin & Sons Co., 920 National building, Minneapolis, for a 1-story foundry and addition to a factory to be built at Hopkins, Minn.

K. & F. Brass Foundry, Orrville, O., manufacturer of brass, bronze and white metal products, has been bought out by H. E. Jenet and M. R. Jenet. Plans are under consideration for a new plant.

Doehler Die Casting Co., Toledo, O., Smead and Prospect streets, H. H. Doehler, president, has awarded the general contract for a 1-story plant addition to A. Bentley & Sons Co., 201 Belmont avenue.

International Harvester Co., Rock Island, Ill., has awarded the structural steel contract for a plant addition to Gage Structural Steel Co. The contract for structural shapes for a foundry building has been let to McClintic-Marshall Co.

Dorchester Brass & Aluminum Foundry Inc., Boston, has been incorporated with 1000 shares no par value stock by Martin W. Riley, 1158 Hyde Park avenue, Hyde Park, Mass., to manufacture metal castings.

Quality Alloy Casting Co., Easton, Pa., has been incorporated with $10,000 capital by J. Clem Kline, R. F. D. No. 3, Easton, to manufacture and deal in castings, machinery and parts.

Marion Brass, Bronze & Aluminum Foundry, Marion, O., has built a machine shop in connection with its foundry. Equipment includes broaching and burnishing machinery. The company is in the market for a jolt squeezer.

Super-Maid Aluminum Co., Chicago, has purchased the ground and factory of the Roseland Can & Wire Works, Harrison avenue, Rockford, Ill., and is installing machinery for polishing aluminum utensils.

George L. Barnes, Centralia, Wash., has leased a site and will begin work soon on a one-story foundry for the production of brass and bronze castings. The building and equipment will cost about $30,000.

Russel Wheel & Foundry Co., Detroit, has changed its name to Russel Steel Construction Co., effective Nov. 1. This company is engaged in the fabrication and erection of steel structures and in heavy machine work.

The plant of the Holmes Foundry Co. Ltd., Sarnia, Ont., Canada, a subsidiary of Holmes Foundry Co., Port Huron, Mich., will be reopened about Dec. 1, after 18 months' idleness. The plant will make automobile parts. L. M. Mullholland will be works manager.

The wheel foundry of the Pressed Steel Car Co., McKees Rocks, Pa., was damaged by fire recently. The plant had been closed temporarily. Loss was estimated at $250,000. The building was fully covered by insurance and will be rebuilt immediately.

Kellogg Mfg. Co. Ltd. Toronto, Ont., has been incorporated to carry on the business as iron founder, mechanical engineer, and manufacturer of machinery, tools, implements etc., with $10,000 capital by Richmond W. Hart, Charles H. C. Leggott, and Jessie M. Perry.

W. D. Hedge and E. J. Mann, of the Independent Foundry Co., Portland, Oreg., have purchased the Vancouver Foundry & Machinery Co., Vancouver, Wash., and will operate it as the Vancouver Iron & Steel Foundry Co. Plans for improvements including a new plant, 86 x 100 feet, are announced.

The stove business in St. Louis has taken on an active spurt during the past two weeks and foundries are working full time. Some manufacturers are so crowded with business that they are diverting a heavy amount of their work to jobbing foundries. One company reports it is 10,000 stoves behind on deliveries.

Aluminum Co. of America, New Kensington, Pa., plans an expansion program. The Arnold seal plant is being doubled in size and a new melting plant is under construction to handle remelting and casting of billets. Latest devices are being installed for remelting and coke handling. This installation will cost over $1,000,000.

Fire, which started in the roof, is estimated to have done about $150,000 damage to the foundry of the Aetna Standard Engineering Co., Warren, O., on Oct. 24. M. I. Arms, president of the company, said the fire would not interfere with the company's business, since the material destroyed in the foundry will be purchased in the open market. The company will rebuild and will receive bids shortly.

The machine tool equipment of the Bucyrus Road Machine Co., Bucyrus, O., formerly the Carroll Foundry & Machine Co., was sold at auction Oct. 30, by the Industrial Plants Corp. The grounds and buildings had been sold previously to Charles F. Michael, president, Ohio Locomotive Crane Co., Bucyrus, O., who will equip them for gray iron foundry work and for the manufacture of road building equipment.

Stockham Pipe & Fitting Co., Birmingham, Ala., has awarded contracts for the construction of a large two-story warehouse and shipping building, 104 x 251 feet, and a one-story laboratory, 60 x 95 feet, to H. K. Ferguson Co., Cleveland. Construction will begin immediately, with January 1, 1929 set as the date for completion. Herbert Stockham is president of the firm and L. N. Shannon is vice president and general manager.

## New Trade Publications

CONVEYORS—Stephens-Adamson Mfg. Co., Aurora, Ill., is publishing a series of 24-page bulletins under the title "The Labor Saver." They contain drawings and concise descriptions of typical installations of conveying and elevating machinery.

NICKEL STEEL—International Nickel Co., New York, published in a current booklet a review of its publicity methods to promote the use of alloy steels. Reproductions of its advertising matter are presented.

RESISTANCE THERMOMETER—Brown Instrument Co., Philadelphia, in a new catalog, describes applications and types of resistance thermometers as applied to industry. These instruments are designed to measure temperatures from 300 degrees to 1000 degrees Fahr. They are of the indicating, recording and controling types. A wide variety of uses is shown in illustrations. Construction, wiring and operation of the devices are made plain by diagrams and halftone illustrations.

STEEL WELDING RODS—Fusion Welding Corp., Chicago, has published the first of a series of bulletins designed to give a better understanding of some phases of welding which have been obscure. This is devoted to the influence of carbon in steel welding rods.